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RAILWAY ENGINEERING

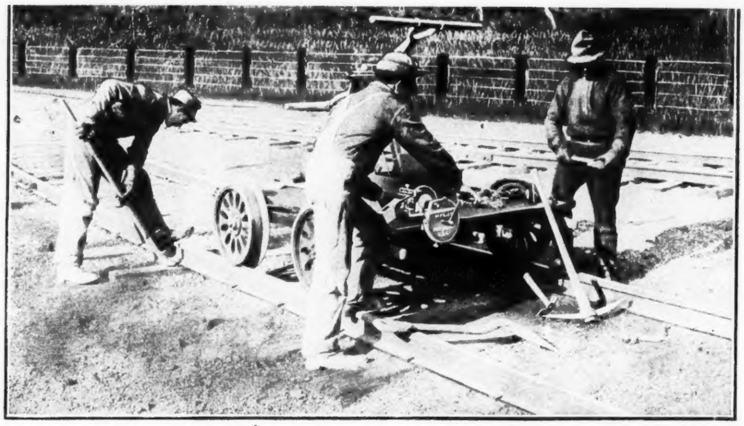
New Series, Vol. XII
Old Series, Vol. XXX
No 4

AND MAINTENANCE OF WAY

APRIL, 1916

NO DELAY

ON ACCOUNT OF DULL TOOLS



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RAILWAY ENGINEERING
AND MAINTENANCE OF WAY
WITH WHICH IS INCORPORATED ROADMASTER AND FOREMAN

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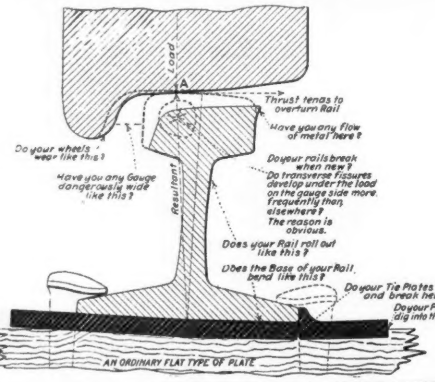
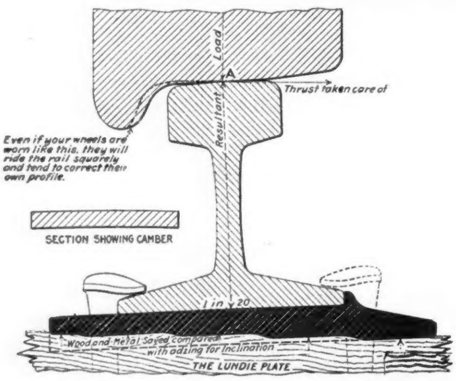
MODERN SCIENTIFIC TIE PLATE PRACTICE

HAVE YOU ANY RAIL APPROACHING THIS CONDITION?



WHY NOT USE THE LUNDIE TIE PLATE AND PRESERVE YOUR RAIL LIKE THIS?



THE LUNDIE TIE PLATE

A SAFETY DEVICE — AN ECONOMIC DEVICE

THIS PLATE WILL PAY FOR ITSELF IN SAVING OF RAIL AND WHEEL WEAR ALONE.
IT IS MUCH MORE THAN A MERE TIE PLATE.
COMPARED WITH AN ORDINARY FLAT PLATE IT HAS THE FOLLOWING FEATURES:—

SAFETY

It will minimize tendency to accident by so-called track spreading.

It will reduce internal stresses in the rail, so tending to eliminate rail fractures.

ECONOMY

It will give rail over thirty per cent. longer wearing life.

It will give wheels a similar increase in life.

It will hold the gauge, and so save maintenance expense in re-gauging.

It will not injure the fibre of the tie.

EASY RIDING

It will present an adjustable bearing to the base of the rail as a wheel load passes over it, owing to the camber.

It will not rattle.

COST

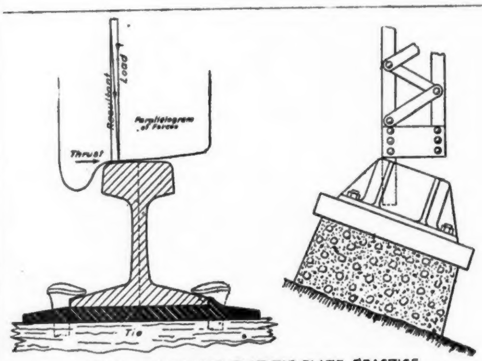
It is not simply a flat piece of metal with holes punched in it and thus cannot be compared with other plates on a price per pound. For equivalent efficiency, however, it compares favorably in price per plate with any other tie plate on the market.

The Resultant Force, due to a wheel load on a rail and the wedging action of the coning of the wheel, is at right angles to the direction of this coning.

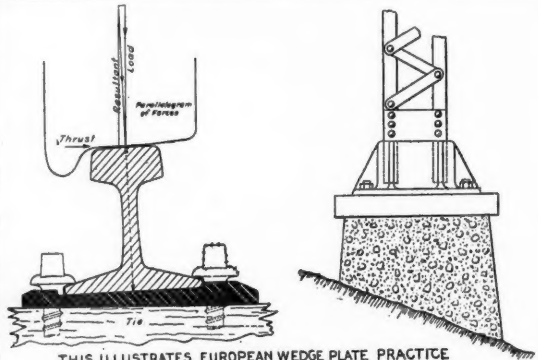
This Resultant is the force bearing from the wheel on the rail, independently of the necessary "nosing" action of the wheel flange on curves.

In the diagrams shown below, the bearing of the wheel on the Rail, Tie Plate and Tie is compared with the load acting between a Steel Column resting, through a Shoe and a Masonry Foundation, on Sloping Rock. The column load is vertical, while the bearing of the wheel on the rail is at an inclination of one in twenty. The track sketches are to scale, while the foundation sketches are exaggerated to emphasize the point made.

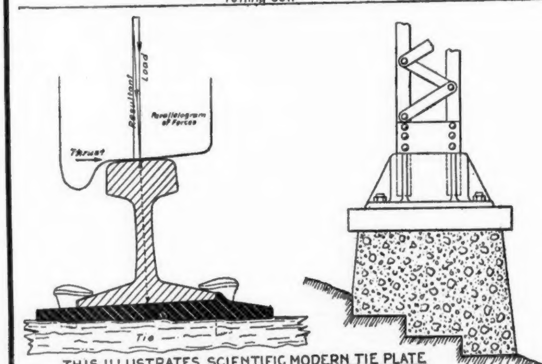
The Wheel	corresponds	to	the	Column
" Rail	"	"	"	Shoe.
" Tie Plate	"	"	"	Masonry
" Tie	"	"	"	Sloping Rock



THIS ILLUSTRATES FLAT TIE PLATE PRACTICE.
Rail and Plate tend to "roll out."



THIS ILLUSTRATES EUROPEAN WEDGE PLATE PRACTICE
Note the heavy bolts required to keep the plate from "rolling out."



THIS ILLUSTRATES SCIENTIFIC MODERN TIE PLATE PRACTICE.
The Seating of the plate is normal to the resultant force bearing on it. The Plate will not "roll out" from the resultant force shown, but will hold the track to gauge

In addition to being seated at right angles to the resultant of the forces acting on it, the Lundie Tie Plate is cambered lengthwise to the rail, so permitting the rail to travel over the surface of the plate with a gentle flexing motion as wheel loads approach to and recede from it, giving smooth riding track. With a flat plate, the rail, under approaching and receding wheel loads, tilts the plate by coming in contact with its edges, so inducing rocking ties and rough riding, clattering track.

New Wheels and Rail over The Lundie Tie Plate will tend to retain their standard contours. Worn Wheels and Rail over The Lundie Tie Plate will tend to return to their standard contours

JOHN LUNDIE, 52 BROADWAY, NEW YORK CITY

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Appreciation of the Conventions

The conventions are over and we can take stock of what has been accomplished. Perhaps more important than the concrete figures of attendance and the specific recommendations of committees is the atmosphere of co-operation that is fostered by such gatherings. Ours is a tremendously big country, and to maintain progress in various pursuits, as a unit, it is necessary that men come together to represent all of the sections, in forming policies which are to be national rather than local or provincial.

When one technically trained man from the extreme West, and another from the extreme East, bring their experiences to the same convention floor; when with them are associated hundreds of other keen minds from points between, all bent on the solution of some common problem, the diversity of their experience, and hence of their viewpoints, expedites the accomplishment of their purpose. The ideas and plans of the creative genius are matured under the guiding conservatism of the equally gifted analyst of experience.

The amount of really hard work done by the various committees in the preparation of their reports is not apparent when one glances at the finished product as it is presented to the association. Not only is the gathering of suitable and pertinent material a more or less difficult task, but the sorting, placing and appraising of its value is a slow and laborious performance, which taxes the abilities of the committeemen and takes up a good deal of time.

The work, however, when properly and efficiently done, creates a permanent value for the use of the every-day railway man, which he could never get were it not for the co-ordinated effort of the association as a whole. The thanks of the railway world is in reality tendered to the workers in many fields, as they place before the members the description of devices and methods and the explanation of how work is done, and the many difficulties encountered and overcome by men having the same end in view, but working in different parts of the country, and amid a variety of circumstances which is a powerful modifying factor in the result sought for.

The fruit of this labor of the few is made available to the many, and opportunity is afforded for question and explanation in arriving at a complete understanding. There is this business aspect to it, it is part of a healthy and pleasant experience. It is really education, but taken in under, one might say, most enjoyable circumstances, and knowledge so acquired, is retained.

Creosoting Railroad Ties

In considering this important subject one has a better chance to understood it by taking what might be called a microscopic view of the structure of the tie, and this can be done by the exercise of what Tyndall called the "scientific imagination," which enables one to see in the mind's eye that which is not visible to the organ of physical sight. By Tyndall's process the tie reveals itself as composed of woody fiber separated by an immense number of minute pores or small, more or less circular passages parallel to the long, horizontal axis of the tie.

To the microscope the tie appears to be honey-combed with a series of channels like the cartridge case of an ordinary revolver or like the parallel barrels in the now obsolete French field piece, the mitrailleuse. This simile is not strictly accurate, because the barrels of the gun and the cartridge case of the revolver are machine-made, and these channels do not meet or intersect or run one into another. In red oak the channels may run continuously for long distances. In many species there are no continuous open channels or pores. The tie generally contains a multitude of approximately parallel channels, which during the life of the tree from which the tie was cut were the capillary tubes up which the nourishing sap of the tree was able to flow.

A tie cut from such a tree is more or less damp along these internal tubes and before the process of drying is completed it is likely to be attacked from within by some form of fungoid growth. Fungus is well known to be vegetable matter and germinates from a minute organism which always enters from without. One of the peculiarities of this plant-like growth is that it can live and multiply without any necessity for sunlight. Fungus is destitute of chlorophyll, or green coloring matter, so familiar to us in the verdure of the leaves and foliage of trees, flowers, shrubs and weeds. This green coloring matter, in the presence of sunlight, is able to separate the carbon from the carbonic acid of the air and apply carbon to the building up of its own tissues.

The absence of chlorophyll in the fungus prevents it from doing this, and restricts it to the absorbtion of the carbon from other organisms which have already assimilated it. A fungus is therefore compelled to live on matter in which the assimilation of carbon has already taken place, and an ordinary railroad tie affords it the very kind of sustenance it requires. The decay of timber is thus caused by the presence of some form

of fungoid growth, which produces the condition which we call rot, and indeed other forms of decay may take place under appropriate circumstances.

The usual method of preventing this form of decomposition is by coating the internal surfaces of the pores of the wood with the oil of creosote. This is one of the important coal-tar products, and is a powerful antiseptic. The presence of creosote not only kills the minute organism from which the fungus grows but generally renders the dead wood of the tie entirely unfit for vegetable or animal life. From this fact it is easy to see that although the wood is saturated, as we say, with the oil of creosote, the physical fact is that the internal walls of the capillary tubes or pores of the wood are in reality "painted" over with a film of creosote. This is practically what takes place in the "empty-cell" creosote treatment. The "full-cell" treatment supplies enough creosote to entirely fill each pore of the treated wood.

The creosoting treatment may be very briefly described as subjecting the wood to a process which empties the ends and to a certain distance the pores, of the air contained in them, and in filling these minute spaces with the antiseptic, coal-tar product. The ties to be treated are placed in a large air-tight cylinder or tank and the air is then pumped out. So completely is the progress carried on that the air imprisoned in the pores of the wood escapes. The oil of creosote warmed or even made hot is then introduced into the air-exhausted receptacle containing the ties until it is quite full and the warm liquid readily impregnates the wood at the ends, and at least approximate, saturation is assured by afterwards pumping air into the tank and leaving the timber soaking in the oil of creosote under a pressure of perhaps from 100, 120 or 150 lbs. to the square inch.

Prof. Raphael Meldola, F. R. S., tells us that one cubic foot of wood absorbs about a gallon of oil. The actual quantity, of course, varies with the structure of timber which is treated and depends on the number and size of the pores in any species of tree and also depends on the method used for treating.

A process not unlike this is resorted to with pipes intended for water mains, where the coating of their internal surfaces is effected by dipping them into tar or asphaltum. The whole problem of tie preservation is thus seen to be the application of science in combating the tireless effort of Nature to provide for the perpetuation of even the lower and least developed forms of life. We cannot hope to outstrip Nature, but for industrial and economic reasons we may at least restrict her activity or partially delay for our own purposes the natural and inevitable deterioration of the timber which plays such an important part in the transportation systems we have devised. It is as if we had halted the flowing reel in a moving-picture machine and were rewarded by seeing only the immobile faces and figures of the actors held in unwonted but effective repose.

National Ownership of the Railroads

It would seem that there are at least three classes who are inclined to be in favor of public ownership of the railroads; the stockholders who would rather have government bonds in place of capital stock; well meaning individuals of socialistic ideas who believe that under government ownership better service, at less cost, will result and those who are of the notion that, on general principles, the government ought to own the railroads. This last class includes the active politicians who see visions of a great machine created for their especial benefit.

Whether any or all of these views are just or unjust we will not undertake to determine; but we will present the picture of a government owned railroad, as it might appear.

We observe the railroad with all its branches, completely built and in operation, at the moment the government has acquired it and has undertaken to make it pay, continuing its operation in the interest of the public. Its affairs are in the hands of a new cabinet secretary. Clamoring politicians beset him to provide places for faithful supporters who may not know much of railroad business; but they are willing to learn if they have the chance. The secretary supplies the places as rapidly as he can, consistent with his duty and allegiance to his party. The patronage must be dealt out depending upon all the sections through which the railroad runs and every section has its political foreman, upon whom a good deal rests, as we know. If there are not places enough they will have to be created, in time. Where one man was formerly sufficient, two or more seem to be necessary now. Pay rolls are increasing; supply bills in consequence are growing and where two tracks, formerly, more than answered every purpose, four seem to be required. As time goes on, the railroad, from a political viewpoint, does not appear to be doing its share toward the support of the party in power. Extensions must therefore be built. All these additions and improvements require bond issues from time to time and they are freely floated to meet the demands, while the railroads' deficit each year is rapidly increasing. Train service in the hands of incompetents is gradually growing worse, and the shipper and consignee have now abandoned all hope that goods will be transported and delivered promptly. With affairs going from bad to worse the only remedy to meet the deficits and pay interest is a more general income tax and mostly all classes of wage earners will submit to it with the assurance that eventually the railroad will be a financial success in which the whole country will share. Meantime the people who once called the railroad a "menace" and begged loudly for governmental ownership talk in violent terms the other way and ask "for what good was all this?"

The effort—based largely upon political greed—not only with a semblance of keeping abreast of the times, but ahead of them, is constantly forcing extrava-

gances in operation and other useless expenditures which a critical public finally awakens to. Tax budgets call on the people to make good these supposed needs. They shoulder a burden (of which they can never be relieved), not only to their detriment in the matter of service, but the cost of maintenance and support as well. This in a very general way is the picture of a railroad under government ownership as we see it. The appearance of things changes from time to time. What is indistinct in some lights may develop into a definite object at other hours, so that if the picture from our viewpoint does not meet with the approval of some of our readers, who may be loudly advocating government ownership of the railroads we shall be glad to have another rendition of it as they see it; or, if they prefer, let them investigate what municipal ownership of public utilities has accomplished in some notable instances and what the results have been in other countries, where these steel highways are owned and operated by the government.

As one forceful example, we might mention that Lord Claud Hamilton, in England, in a recent address at the annual meeting of the Great Eastern Railway Co., said: "Does it not strike you how marked is the contrast of the smooth and successful working of the gigantic task imposed upon the Committee of General Railway Managers with the reckless and haphazard manner in which much of the work under, or partially under, government control has been administered? The reason of this difference is obvious: In the one case the work has been performed by practical, trained business men; in the other case, the preponderance of politicians, lawyers and government officials—in many instances without any real business experience—has been the cause of a terrible waste of public money, of inefficiency and of unpardonable delay. These mistakes are, I am glad to say, being gradually rectified. But the war has been in progress for one year and seven months, and it seems a grave reflection upon our system of government that such maladministration should have been possible, and in the best interests of the country it is greatly to be deplored."

Leakage from Rails and Efficiency of Bonds

A study of the problems connected with the leakage of electric current from railway rails has recently been completed by the Bureau of Standards, Department of Commerce, and the results have just been published in Technologic Paper No. 63. The theory of the leakage of current from railway tracks has been developed mathematically, and curves were plotted to aid in the interpretation of the results. The conclusions to be drawn from the formulas and curves are discussed with special reference to practical problems in electrolysis. It is shown how the escape of electricity from the rails is affected by increasing the track conductivity, as by careful bonding of all joints; by the use of a high resistance roadbed; and by shortening the distance over which a power house or sub-station furnishes power.

The paper is intended primarily for electric railway engineers, but steam railway engineers will find it most useful, and also others who are familiar with electrolysis problems. Copies may be obtained free. The Bureau of Standards have also embodied information regarding Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Technologic Paper No. 62, just issued. The paper is largely a compilation of information in the nature of data and opinions submitted by forty-two companies who answered inquiries sent out by the Bureau. Analysis of the data shows that soldered bonds have been demonstrated to be unsuccessful and are now practically obsolete, while all other types of standard bonds are capable of giving good results, but only when carefully installed.

Loose rail joints are shown to be the most prevalent cause of bond failures. The adoption of various types of welded joints to take the place of the common bolted joint appears to be more frequently used. The whole problem of track bonding is shown to be in a state of evolution owing to new inventions and recent improvements in methods of construction, and as a result complete standardization of these practices cannot be expected at present. Copies of the publication will be sent free to those interested who apply to the Bureau of Standards, Washington, D. C.

Examples of Excellent Discipline

To determine how well train regulations and signal rules were observed the Pennsylvania management made 4,364,519 tests during 1915. For every 1,110 trials only one error occurred—99.9 per cent of perfection. In four sets of tests, which included obedience to so-called "Stop" signals, there were no failures whatever; 68,941 observations relating to the shifting of trains were made, resulting in but 17 errors. Out of 342,991 tests for obedience to safety rules covering track workmen, 73 only showed a disregard, or one error in 4,699 trials. The percentage of accidents to employes decreased by 11 per cent. In 62,934 tests relating to rules governing watchmen employed at grade crossing there were but eight failures. These are wonderful showings, indicating a system of superb discipline, reflecting great credit on the Pennsylvania management and tending to prove that railroad business is reaching the position of an exact science.

The Cuban Railroads

Our minister at Havana, Cuba, has informed the State Department at Washington that the President of Cuba has signed a decree, dated February 17 last, appointing a commission to consider the question of nationalizing the railroads of Cuba. A report from this committee will be forthcoming within the next few months. It is probable that it will be interesting and instructive.

Railroad Bridge of Steel and Concrete

By M. ROBERT CONOVER

A very interesting structure is the bridge of the New York & Long Branch Railroad, over the Shrewsbury river at Red Bank, N. J. This bridge, recently completed at a cost of about $250,000, is a double-tracked structure, replacing an old double-tracked wooden bridge structure which was condemned after many years of use.

The building of the new bridge was accomplished in precisely the same place as the old one had been and without interruption of traffic other than the use of but one track at different stages of the work and the slowing down of trains.

The concrete work was executed by G. B. Spearin of Spearin & Preston, contractors, New York City, and The American Bridge Co. of New York City had charge of the steel work.

The bridge is of the girder type of construction. There are 20 supports, each support consisting of 4 piers, each resting upon its own foundation of concrete. These concrete foundations, shaped like frustums of a pyramid, are 12 ft. high, 5 ft. square at the top and 14 by 11 ft. at the bottom. Each rests upon a sub-foundation of 28 piles driven to hard bottom and penetrating the river bottom to an average depth of 40 ft. The hard bottom of the river here is sharply "V" shape. Over this is a layer of silt and shells. The silt extends up to low water in some places lying bare at low tide. This material is so soft as to be easily pumped to a certain depth where it hardens to a compact mass of shells.

About each set of piling a cofferdam is built. The usual system of walling was employed. The mud and water were pumped out to a depth of 10 ft. below the river bottom. Each pile is capable of sustaining 15 tons estimated, and each group would sustain a load of 420 tons.

The piling used were 4-in. tongued and grooved sheet piling driven with a small steam hammer. It was difficult to place the piling directly under the old trestle, but it was accomplished by hanging the hammer on the end of the derrick boom, thus enabling it to work at an angle.

The concrete foundation rests upon this piling below water. Thus the piling, being under water at all times, is practically everlasting. Extreme care was taken during the work to get the foundations as good and well placed as modern methods of construction render possible. When the steel was erected, there was absolutely no trouble experienced with either the placing of the anchor bolts of the separate piers or with the spacing of the pairs of piers in either direction.

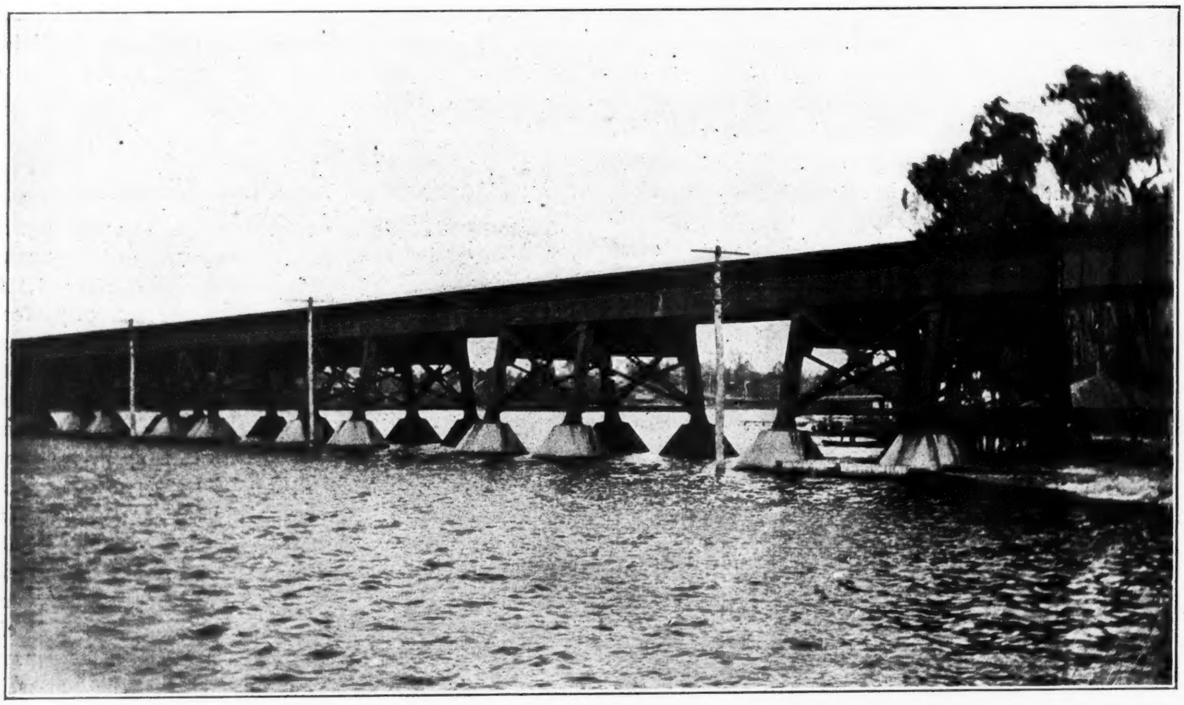
The plant used for the construction of the foundations was designed especially for this job and was one of the most efficient yet devised.

Water for the concrete was obtained from a well driven through the river bed and the proportions of the ingredients for the concrete were 1:2:4 or one part cement, two parts sand and four parts gravel.

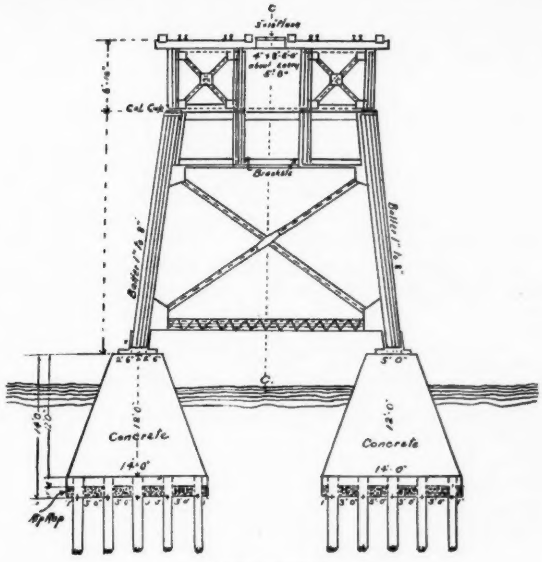
Measuring center distances, the bridge is 25 ft. across; and lengthwise, 25 ft. between the foundation piers and 50 ft. between each set of piers from center to center.

The broader sides of the concrete foundations extend across the bridge space, thus strengthening it against the lateral stress from rapidly moving heavy trains.

The grade of the new bridge is 2 ft. higher than the old structure, which makes it less susceptible to shock from trains coming upon it from the north or toward the town. The old structure suffered so much from



Steel and Concrete Bridge Over the Shrewsbury River, on the New York & Long Branch

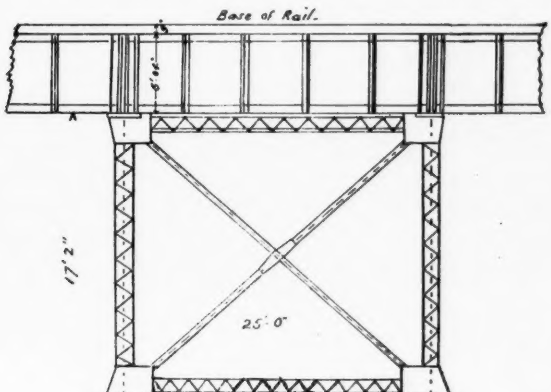


Sectional View, N. Y. & L. B. Bridge

this stress that its supporting timbers were forced one foot out of plumb.

The fact that the present structure has a heavy system of lateral bracing which enables it to absorb the lateral stresses caused by trains entering and crossing it; that being of steel, it is capable of transmitting and distributing stresses more evenly and conforming more closely to calculations, and the superiority of rivetted joints of the steel structure to the bolted joints of the old wooden bridge give the new work strength to resist the racking strain of heavy express trains which no wooden structure can equal.

The piers are tied at their bases by lateral and lengthwise girders and also at their upper parts where the transverse braces terminate. Brackets crosswise of the bridge distribute the weight of the superstructure and

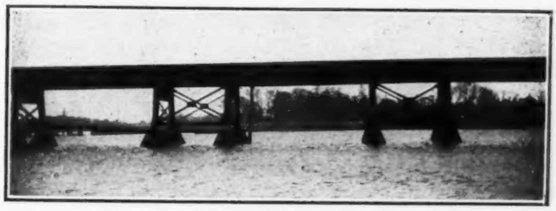


Drawing of Side of N. Y. & L. B. Bridge

the section of the superstructure immediately under each roadbed is strongly braced by transverse braces.

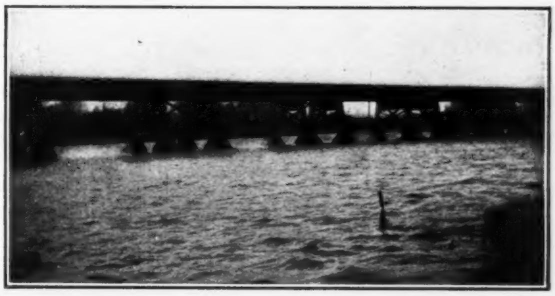
The life of this bridge is estimated at thirty, forty or more years depending upon its care, painting, etc.

During the construction of the new bridge, the old bridge had to be made perfectly safe for the daily



Concrete and Steel Used on N. Y. & L. B. Ry.

traffic to and from New York. As previously mentioned the old wooden structure had been forced out of plumb by the stress of heavy traffic during its years of service. By means of hydraulic jacks—small and insignificant looking affairs in themselves—this heavy structure was shoved back to its proper position in a few minutes after the jacks were put to work. The old structure was then



Perspective View of Bridge Over Shrewsbury River

braced and sustained the weight of trains during the progress of the work.

A narrow railroad track near to the water's edge was used to deliver the concrete for the foundations at the various points needed. Cable cars were run upon this to carry the materials.

Maintaining the Track Force

Reasons for and Reeults Anticipated from Maintenance of the Track Force for the Entire Year

The question of maintaining the track force the year round or reducing it in the fall was the subject of a recommendation by Sub-Committee No. 1 in their report presented at the last meeting of the Roadmasters and Maintenance of Way Association.

Without endeavoring to reproduce the exact words of the committee report the substance of the recommendation for the maintenance of the track force was substantially as follows:

A sub-division should have floating gang, foreman and crew of picked men, compensation to be slightly more than the regular section men and the size of the floating gang to be determined by circumstances. This gang should be equipped with portable camp and tools for various track work. This crew should be used to do various special jobs, such as building new side tracks, transferring cars, handling snow and various other jobs. At times when special work is slack it should assist some foreman in doing heavy work and give the foreman who is behind in his work a helping hand.

The sub-committee expressed agreement with Mr. Costello, roadmaster on the Santa Fe, when he stated that a section crew must be able to see some progress or it will not become interested; because work, if going along smoothly, accumulates momentum.

A floating gang of this kind would tend to encourage section crews and so increase their efficiency. The special work done by these men in time will qualify them to fill positions of assistant foreman and foreman as they will get more experience than regular track men. The committee recommend that section forces be maintained the year round because the practice of reducing forces to the minimum in early fall does not appear to be the best, for with certain limitations a force more nearly uniform throughout the year is economical for reasons that follow:

It helps to secure a better grade of laborers. Such men will enter and remain in service and be satisfied with a lesser wage if assured of work all the year round. If in a climate that will permit, such work as relaying rail, gauging track, rebuilding fences should be done in the late fall and early spring and much other miscellaneous and necessary work can be carried on throughout the entire winter. There is much less work to be done during the summer than in cases where the force is reduced below a reasonable number early in the fall, and consequently a less number of men may accomplish the season's work, thus greatly reducing the necessity for large extra gangs or floating gangs.

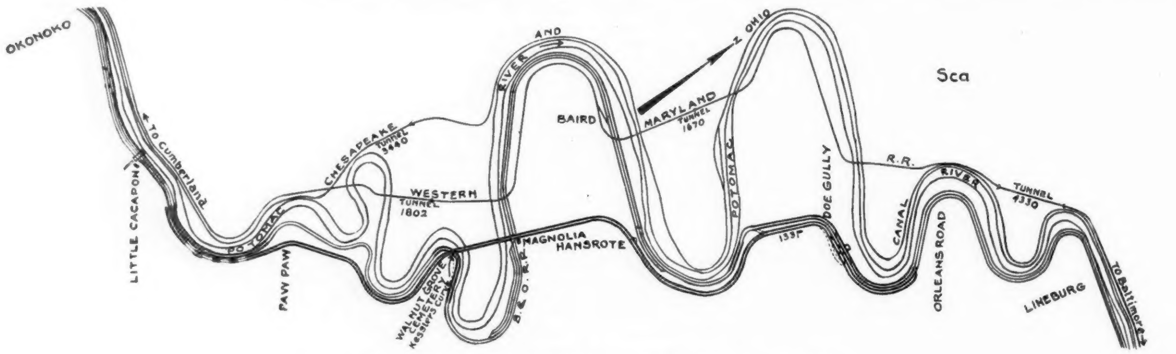
The abnormal demand for laborers now so apparent, with consequent increases of wages, and reduced efficiency, always incidental to supply being less than demand, would not be an annual occurrence with unknown but certainly considerable loss to the railway. Steady work brings to railways a better class of laborers and means that the available supply of efficient track foremen will also increase. This, in turn, means less waste of labor, better care of material, little loss of scrap, less accidents, and more safety.

A blacksmith on each sub-division to repair tools, make light repairs to section cars, etc., was also part of the recommendation, because it is believed that such a man, working under the direction of the roadmaster or supervisor, would come nearer, by the process of repairing, to getting the full life out of each tool or appliance for the reason that he would be getting suggestions from the men who use these things and could go more into detail with him as to their defects. In other words these men have to "live with" and operate the appliances, and it is a vital matter to them to have the tools not only in good condition, but fixed up so as to suit the practical circumstances which these men daily encounter in their work.

The committee also recommended the employment of two carpenters to relieve the section men.

Magnolia Cut-off on the B. & O.

An article published in the January issue of this magazine has brought requests from a number of our readers for more information, which has been secured from the construction engineers.

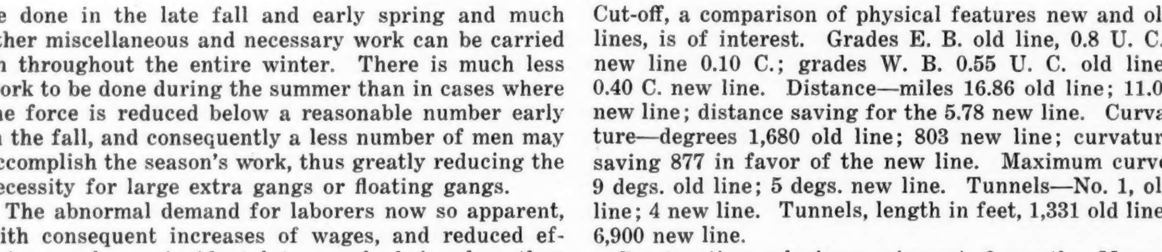


Map of the Magnolia Cut-Off on the Baltimore & Ohio

Regarding the Baltimore & Ohio Railroad, Magnolia Cut-off, a comparison of physical features new and old lines, is of interest. Grades E. B. old line, 0.8 U. C.; new line 0.10 C.; grades W. B. 0.55 U. C. old line; 0.40 C. new line. Distance—miles 16.86 old line; 11.08 new line; distance saving for the 5.78 new line. Curvature—degrees 1,680 old line; 803 new line; curvature saving 877 in favor of the new line. Maximum curve, 9 degs. old line; 5 degs. new line. Tunnels—No. 1, old line; 4 new line. Tunnels, length in feet, 1,331 old line; 6,900 new line.

Construction—placing equipment, 2 months, Magnolia Cut-off work, 17 months; total number men employed, 2,500; equipment, power shovels, 22; locomotives, 55; locomotive cranes, 2; dump cars, 550; concrete plants, 6; traveler, 1; air and steam drills, 116.

Direct savings per annum, elimination of helper engines, $40,000; eliminate overtime, $20,000; mileage, wages, tonnage, etc., $140,000; other estimated savings, $300,000; total, $500,000. Density of traffic, 130,000 tons per mile of road, 20 per cent increase in five years. Mikado or 2-8-2 locomotives used—tractive power, 54,-600 lbs. Tonnage rating E. B. 6,500 tons.



Profile of Baltimore & Ohio Railroad at Magnolia Cut-Off

American Railway Engineering Association

The seventeenth annual convention of the American Railway Engineering Association was called to order at 9:30 a.m., Tuesday, March 31st, at the Congress Hotel, Chicago, by President Robert Trimble. The report of the secretary, Mr. E. H. Fritch, gave the membership of the association as 1,336, an increase of 100 during the year. Since the 1915 meeting of the association ten members have died. The association was reported to have a cash balance of $13,880.40.

Report on Signals and Interlocking.—Committee X

The report of Committee X on Signals and Interlocking, of which Mr. C. C. Anthony was chairman, was substantially as follows: No revision of the Manual was recommended. In 1914 the committee submitted a preliminary report. Since that time the committee has given the subject further study and here submitted a report embodying the conclusion at which the committee had arrived. In the preliminary report it was stated that signal work draws men from every class of mechanics. Any of these different classes can be developed into general signal men, but, in the present state of the art, a training along electrical lines is almost universally essential.

In all branches of engineering activities there are specialties which can only be learned by experience. The track circuit with its relay is one of these specialties in signal work. It is a combination which is not found in any other activity and must be studied as a part of signal work. Because of the necessity for the display of correct signal indications, the circuits must be studied from an entirely different standpoint from those found in other branches of electrical engineering; and the demand for fool-proof apparatus and its maintenance creates a demand for men especially educated in a practical way to think and act correctly in emergency. Many of the operations can be carried on by untrained men. A large share of the work involves very little knowledge; but if men are used for these duties in connection with others of the same general attainments as in other activities, there seems no way by which they can progress or learn the things that will fit them properly to inspect and maintain the more complicated parts of the installations, except through practical experience which, in turn, must involve a general force devoting its entire time to signal work or closely allied activities. Because the main controlling power of signal apparatus is electrical and because of the special training required, they did not recommend, as a means of obtaining economy and efficiency, a combination of signal and track forces.

The subject of the capacity of a single track was assigned at the outset to a sub-committee, consisting of Messrs. Peabody (chairman), Ames, Denney, Eck and Patenall, to which Messrs, Dodgson, Ingalls and Scott have since been added. The same subject is assigned by the Railway Signal Association to its committee on Signaling Practice and the work is carried on jointly.

This year the sub-committee was fortunate in securing the co-operation of Mr. F. L. Dodgson, consulting engineer, General Railway Signal Company. Mr. Dodgson has contributed an analysis of the effect of passing-siding location on the capacity of single track to secure the maximum. In considering the effect of passing-siding locations on the capacity of single-track railroad, it would seem to be the most logical thing to first determine, if possible, what rule or rules, if any, must be followed in order to so locate the sidings that maximum capacity of the road will be obtained. The committee recommended that the matter on Capacity of Single Track be accepted as a progress report.

Discussion.—The report on Capacity of Single Track was accepted as a progress report. The list of matters acted upon by the Railway Signal Association, at its 1915 meeting and adopted by letter ballot in 1916, including certain revised titles, was received for publication in the Manual for the information of members of the American Railway Engineering Association. The subject of requisites for switch indicators has not yet been crystalized in satisfactory form, and was accepted as a progress report.

Report on Signs, Fences and Crossing—Committee IX

Committee IX, of which Mr. W. F. Strouse was chairman, made a report on Signs, Fences and Crossings, which is briefly as follows: Last year the committee made a very exhaustive study of the subject-matter in the Manual; it now made no recommendations for changes this year in any portion of the Manual. The subject of track construction and flangeway at paved street crossings had been carefully considered, and without a thorough review, it was considered unwise to suggest changes.

When the conclusions were recommended for inclusion in the Manual strong opposition developed, which seemed to center particularly about recommending the use of 141-lb. 9-in. girder rail. Two distinct conditions are implied, namely, a style of construction suitable for use at paved street crossings, and one suitable for tracks laid in paved streets. The report seemed to indicate that it referred to tracks in paved streets rather than at paved street crossings. Separate conclusions are necessary to cover each condition, as implied in the outline.

If the vehicular traffic on these streets is heavy and they are paved with standard granite blocks of an average depth of 6 ins., the ordinary T-rail is not deep enough to provide a proper sand cushion over the ties. This has brought about the very general use of the 141-lb. 9-in. girder rail with flangeway, although a slightly shallower rail might prove just as satisfactory. If the vehicular traffic is light and other conditions are favorable to the use of sheet asphalt, asphalt, wood or vitrified blocks, the regular T-rail construction is not only possible but preferable.

If the subgrade is perfectly dry and the street is paved with sheet asphalt or grouted blocks on a substantial concrete base, the matter of drainage is not so important, as conditions tend to improve with age. If the subgrade is wet, the question of drainage is important.

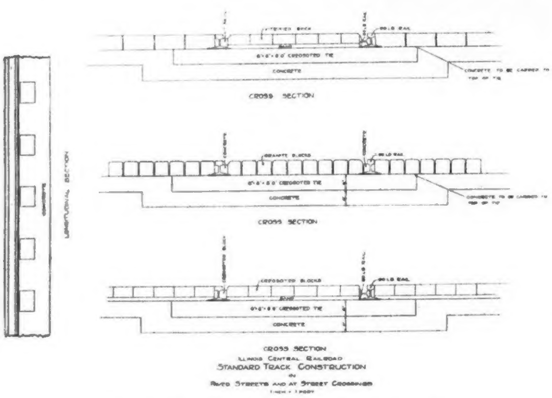
In growing cities and towns, especially in the West, the demands for carrying the standard street pavement across tracks at street intersections have become so frequent and insistent that it is of great importance to the railroads. In many cases the municipalities require a concrete base under and between the ties. This form of construction has not always proved satisfactory under heavy railroad traffic; hence the results have not warranted the expense. The use of ballast under high-speed tracks seems to be more satisfactory.

The fundamental principle underlying the design is that the street paving adjacent should in no way be connected to or be dependent upon the track, thus giv-

ing it a chance to slightly change its position vertically without disturbing the surface of the crossing or that of the adjacent street paving.

For flangeways rails have been used of a lighter section set upright on blocks to provide proper elevation and bolted to the running rail at intervals of 6 ft., the proper flangeway being maintained by the use of fillers or separators.

In the report of this committee three years ago attention was called to the fact that street car companies seemed to pay more attention to the details of construction of their tracks in paved streets than had been done by steam roads. Attention was called to the details



Illinois Central Standard Construction

of construction of tracks by the Montreal Tramways Company.

After a careful study of the plans received and of construction with which the committee is familiar, it had reached the conclusion that two distinct conditions are to be met and that three distinct forms of construction are desirable.

For paved street crossings, where the general direction of traffic is at right angles to the track, the regular standard track construction of the several railroads should be used, and the space occupied by the track or tracks planked over. The flangeway should be formed by using a rail laid upon its side and properly secured to the ties or set upright and bolted to the running rail.

For tracks in paved streets, subject to heavy traffic, requiring granite block paving, the construction should consist of stone or gravel ballast not less than 12 ins. deep, treated ties and 141-lb. 9-in. girder rail.

For tracks located in streets subjected to light traffic only, the construction should consist of standard track construction, using treated ties, stone or gravel ballast. A form of flangeway in general use is that provided by laying a rail upon its side with the head resting against the web of the running rail and the base against the edge of the adjacent planking or other paving material.

A serious objection to this flangeway is the fact that it cannot be used at joints in the running rail without cutting out the head opposite the angle bar or eliminating the flangeway entirely at the joints, which is frequently done. Another form of flangeway quite common in plank crossings is either to leave sufficient space between the gauge line and the adjacent planks or to bevel them to fit. This is somewhat dangerous for horses.

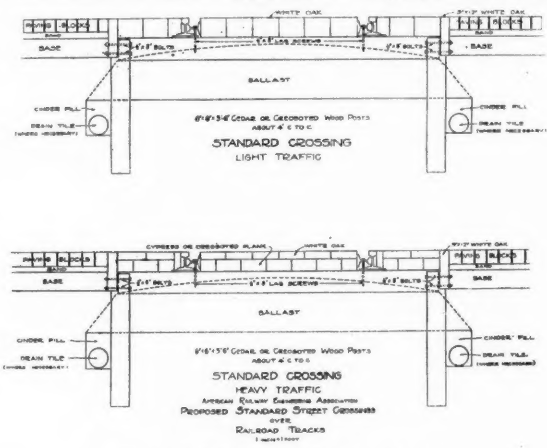
Another method is to fit one of the various forms of paving blocks against the web of the rail between the head and base. This form of flangeway would probably be satisfactory in tracks where the speed is low, but could not be recommended for use in high-speed tracks. The form of flangeway which most nearly meets all requirements, and at a moderate cost, is that provided by the girder rail now extensively used. In the matter of flangeways for tracks laid in paved streets, the committee feels that the most satisfactory construction is that obtained by the use of the 141-lb. 9-in. girder rail with flangeway. This construction is cheaper in first cost than where a relaying T-rail is used with the main rail to form the flangeway. It will permit the use of any kind of paving; provides a flangeway for the wheels; leaves no openings in which animals can get trapped; provides a shoulder against which to place the paving and requires no maintenance as long as the rail lasts.

Railway signs naturally fall under two divisions or classes: One applying to the general public, the other to the employes of the railroad companies. Of the former, the principal signs are public and private road crossing and trespass signs. Under the latter may be mentioned whistle and ring boards, clearance and mile posts, right-of-way monuments, bridge and trestle numbers, etc.

The laws of about 75 per cent of the states reported are more or less specific as to what shall constitute a legal highway crossing sign, that is, the general design, the wording of the inscription, size of letters, etc. In no case, however, do the laws respecting trespassing state what inscription shall appear on trespass signs.

In most cases, certain illegal acts are specified, but no style of warning is suggested, it being left to the civil authorities to make arrests and inflict such punishment as the laws of the various states provide, usually fines or imprisonment, or both, at the discretion of the court.

The committee has made a study of the laws relating to the class of signs applying to employes and finds



Proposed Form of Construction

the only signs covered by laws, and that only by implication, are whistle and ring boards. These signs are covered by a quite common provision in the laws of the different states.

We have all no doubt at some time wondered what prompted or inspired the wording on the various signs and warnings which have from time to time been brought to our notice. In some states, "Look Out for the Engine," in others "Look Out for the Locomotive," while in the majority of the states the public is warned to "Look Out for the Cars." As the locomotive usually precedes the cars the natural inference would be that either the other styles of warning would be adopted.

Various stories have gone the rounds respecting the origin of the warning "Stop, Look, Listen." In its investigation the committee found that it was adopted by the Philadelphia & Reading Railway July 23, 1891. About that time this company acquired the Gettysburg & Harrisburg Railroad, and on an inspection trip over that road several officials of the Philadelphia & Reading Railway noticed that sign at a number of crossings. This sign has since been adopted by a number of roads.

As concrete fence posts had been so fully studied during the past four years, the committee felt somewhat at a loss to know what feature of the subject could be studied with profit this year. The feature which appealed especially to the chairman was the change in sentiment which has developed in regard to the manufacture of concrete fence posts during the past ten or twelve years.

Discussion.—The only subject presented for adoption for the Manual by this committee was a plan for street crossings. The discussion showed several points on which members of the association disagreed with the committee, and the plan was referred back to the committee for further consideration.

Report on Water Service—Committee XIII

The report on this important subject was presented by Committee XIII, of which Mr. J. L. Campbell was chairman. The report in brief is as follows: In its report to the sixteenth annual convention in March, 1915, the committee submitted for approval a number of important changes in the subject-matter embodied in the Manual under the heading of "Water Service."

The committee formulated and the secretary of the association sent to the railroads various questions on the subject. On account of lack of uniformity and incompleteness of the replies received, it would not be wise to attempt general or specific deductions from the data given. The inquiry has undoubtedly brought together considerable information of some value, but the committee raised the question whether or not an investigation of this kind results in any general substantial advance in the state of the art, especially when it involves so many diverse conditions having no general application such as are found in pumping the water for American railways.

Those who have given some attention to the details of the subject generally agree that the cost of pumping water at a water station frequently has little relation to the cost of pumping at another station and gives no basis on which the cost of pumping at another station could be deduced even on the same railroad. The wide variations in cost of pumping are in many cases the result of conditions other than the character and efficiency of the pumping apparatus and substantially unamenable to correction. The committee is of the opinion that the principal value of an investigation of this kind is its direction of the attention of the roads to what they are individually doing and doubtless such investigations of the different phases of the general transportation problem do result in more or less improvement in operating conditions.

Of the sources of water supply reported, about 30 per cent are deep wells of small diameter. The roads are, therefore, securing a large part of their water supply under the most adverse conditions for economical pumping. A good deep-well centrifugal pump offers some important advantages over the old deep-well working barrel in the matter of maintenance, capacity of well and cost of pumping.

The committee on the subject of protection against freezing formulated a set of thirty or more questions, which were sent to forty-four railroads in the United States and Canada, requesting information concerning practice, the troubles encountered due to freezing of the water stations and the remedies employed to correct the troubles. These questions pertained to pipe lines, pumphouses and machinery, tanks and water columns. Answers were received from forty roads.

The minimum temperatures to which the water stations are exposed vary from about 18 degs. above zero in the Gulf States to 50 degs. below zero at some Canadian stations. Some of the mountain roads in the United States report temperature conditions fully as troublesome as the Canadian roads, and roads in the Southern States report low temperatures of short duration.

The penetration of frost is reported as one inch in Louisiana, and three inches, six inches and ten inches in some of the other Southern States. In the Central and Plains States, it is reported variously from 2 to 6 ft. In Canada it varies from 3 ft. in southern Ontario to 6 ft. in Manitoba. Some of the mountain roads in the United States report 6, 7 and even 8 ft. The depth of the frost does not always vary directly with the temperature. Earth well covered with snow freezes to a much less depth than when the snow covering does not exist or is very light. Frost penetrates to a greater depth in gravel or loose rock than in clay; therefore, in the laying of pipe lines, the local conditions must be considered as well as the temperature.

Pipe lines may be laid on the surface without cover in the extreme Southern States. In the central districts the minimum cover is variously reported as being from 2 to 7 ft., and 3 ft. of cover is sufficient in the southern parts of Canada; and at other stations 7 ft. 6 in. is reported as the practice. The size of pipe, amount of water discharged and local conditions will have a bearing on the minimum depth of cover and no inflexible rules can be made governing this depth. Of the forty roads reporting, four report trouble with the pipe cover in use. In Dakota a pipe line froze with 5 ft. 4 ins. cover. One mountain road had trouble in rocky soil. Another had trouble when the cover was less than 4 ft.

When pipe lines cannot be drained, protection is provided in various ways. Sometimes the circulation of the water in the pipe is sufficient, or the pipe may be wrapped with hair felt covered with tarred paper and boxed. The number of layers of hair felt, paper and boxing depend on the length and size of pipe, temperature, etc. When steam is available a steam pipe may be enclosed with the water pipe. A common method is to enclose the pipe in a wooden box and pack the box with sawdust. This method should only be used in the more moderate temperatures. A favorite method, used where the cold is extreme, is air-space insulation—two or more air spaces being built around the pipe and lined with building paper. One road in Canada uses a four-foot square box with four thicknesses of lumber, four thicknesses of 10-ounce felt and four air-spaces. It is important that all boxes of pipe coverings be as air-tight as practicable, and waterproof.

For long lengths of exposed pipe, alternate layers of hair felt and tar paper protected by an outer layer of metal or heavy roofing paper may be used. Four layers each of hair felt and tar paper are used by one road exposed to a temperature of 20 degs. Heavy canvas, painted, is also used for the outer covering without boxing.

Valves should be below frost line where possible. Large valves may be buried and valve stem protected by cast-iron valve box extending to surface of the

ground. Valves which require frequent inspection may be placed in pits, which, in the colder climates, must be provided with double cover. If the covers are air-tight, or nearly so, the air space between them forms an excellent insulation, otherwise the space should be filled with sawdust, manure or other good insulating material. When the frost penetration is deep, it is not ordinarily possible to place the lower cover below the frost line, and in some instances the side walls of the pits are built with air space between outer and inner walls.

Where water is pumped directly from shallow streams or reservoirs, and it is possible to place the suction pipe below the frost line, it may be protected by carrying it out to deep water beneath an earth dike covered with sod. The better practice is to construct an intake well fed by gravity from the stream, the end of the suction pipe being installed in the well. Suction pipes subject to freezing should be arranged so that they will drain after using. The use of intake wells is generally recommended. The warmth of the earth is a factor in preventing the freezing of the water in the wells, and it is generally only necessary to place a single wooden cover over the wells. In colder climates, double covers are resorted to, with air space between, or else a single cover is used and covered with snow, which forms a first-class protection.

The necessity for special construction of pump houses in order to prevent the freezing of the machinery and piping will depend on the power used for pumping and whether the plant is operated frequently or infrequently.

Where steam is used for power, and night and day pumping is done and circulation of water is constant, the heat from the boiler will ordinarily be sufficient to keep all piping and machinery from freezing without special frost protection. In the colder climates the construction of pump houses must provide better protection against cold than further south.

The roof protection consists sometimes of one layer of matched boards—sometimes two layers. The Canadian lines ceil their houses on the inside and double-sheath them on the outside, using building paper between the two layers of sheathing.

The freezing of water jackets and piping on internal combustion engines is experienced by a number of the roads, because they are not properly drained by the attendant and it is either necessary to avoid carelessness or neglect at these places or else see that heat be provided at all times. Few roads have any printed rules regarding the care of water stations to prevent freezing. It would seem desirable that rules for the care of water stations be incorporated in Maintenance of Way Book of Rules.

Tanks infrequently used are subject to more trouble from freezing than those in frequent service. Tanks supplied from ice-cold streams will cause more trouble than those supplied with the warmer ground waters from wells. The troubles due to freezing are generally as follows: The rods operating the outlet valve become inoperative due to the ice forming in top of tank and holding the rod and tank valve shut. After the rods become inoperative, and the pumps are started, the sheet of ice in top of tank acts as a float and raises the rods, thus opening the tank valve, allowing the water to drain out of tank and flood track and vicinity. Outlet valves freeze in shut position. This is frequently due to leaky condition of the valve. Valves in tank bottoms flush with the floor give more trouble than those elevated above the floor of tank and above the frost box. The number of air spaces required vary with the temperatures encountered.

In the Gulf States and in some of the Southwestern States, the use of roofs over tank is not generally necessary to prevent freezing. In colder climates a roof of sheathing laid tight and covered with prepared roofing is common, and in still colder climates the formation of ice on the surface of the water in the tank and the prevention of the valve rods freezing up will be largely overcome if a frostproof floor of matched lumber and paper is built at the level of the top of the staves. Canadian roads find it necessary to entirely surround their wooden tanks with a separate house, tarred felt being applied to both sides of studs and covered on one side by shiplap and on the other with drop siding. The floor over top of tub consists of joist with the under side ceiled with shiplap, the upper side being ceiled with two layers of shiplap with tarred paper between.

The freezing trouble in steel tanks is found to be practically the same as in wood tanks. That is, the rods operating the valve are held by the ice forming in top of tank, the valves freeze when used infrequently and ice forms more quickly if ice cold water from streams is pumped into tank. While wood is a better non-conductor than steel, and the ice accumulation is somewhat greater in steel tanks than in wood, it is not apparent that steel tanks cause any more trouble than wood.

On some Canadian roads steam or hot water coils are used in the bottom of the down leg or mud drum of the steel tanks. A more successful method consists of a stove beneath the mud drum with stovepipe extending up through mud drum and tank near inlet and outlet pipe. No trouble is reported when this was done. Keeping tanks full, or nearly so, at all times during winter will result in less accumulation of ice.

Most roads in territory subject to freezing report trouble with water columns. The operating rods and other operating parts freeze, due to accumulation of ice. The valve rods stick where they pass through the stuffing boxes or where they pass through the flange of the lower upright. The valves and pits freeze, due to insufficient protection. To remedy the above conditions, burning coal oil or kerosene lamps are sometimes placed in the pits or the frozen parts are thawed by means of steam hose where available or by building a fire of oily waste, or thawing by hot water or turning exhaust steam into pit.

All columns should be designed so that they may be drained. The usual arrangement is a valve at base of column, which may be so turned in warm wether that the column will not drain. In cold weather this valve should be turned so that the column will drain into the pit.

Discussion.—No recommendations were made by the committee, the report being submitted for information.

Iron and Steel Structures—Committee XV

The report of committee XV on the subject of Iron and Steel Structures is practically made up of a number of appendices on related matters. The report and the additions by sub-committees is in substance as follows: Mr. A. J. Himes was chairman of the committee. Appendix A on the methods of protection of iron and steel structures against corrosion was in charge of sub-committee A; it is continuing its investigation of common practice in shop painting. The idea of the sub-committee is to obtain accurate information as to the common practice in shop painting.

During the year a new method for coating with metals has been observed. This is the so-called Schoop Metal Spraying Process, by which surfaces may be

coated with easily fusible metals such as lead, tin, zinc, aluminum, copper, brass, etc. The process involves an apparatus called a "pistol" which is a mechanism which feeds wire, of the metal to be deposited, into a blast flame of combined oxygen, reducing gas and compressed air, which results in the issuance from the nozzle of a spray of fused metal. This spray, when directed upon a surface, coats it with the metal. Iron and steel surfaces are readily coated after cleaning by the sand blast. It is claimed that a coating of zinc or lead can be applied at a cost of only a few cents per square foot of surface including the preliminary sand-blasting.

The sub-committee on Columns had not, at present, very much information beyond what was published in the last report. Twenty-four columns will be tested. The bureau to do the work, was asked to proceed as promptly as possible. The tests have been discussed a good deal with members of the American Society Committee and some apparent anomalies have arisen in the test results which, if verified, may be interesting to bring to the attention of the Committee.

Sub-committee C, on the Design, Length and Operation of Turntables, submitted the following report on phosphor bronzes, as information. A test of the hardness of the bronze was provided for in the specifications. Hardness, as distinguished from compressive strength, is one of the primary qualities. It is expected that a systematic record of the results of hardness tests on bronzes of the qualities here required will result in hardness limits which may be specified. There are two methods of determining hardness in common use: the Shore's scleroscope and the Brinell ball method.

The scleroscope is a measure of resilience. The Brinell method consists in applying to a finished plane surface of the metal a hardened steel ball 10 mm. in diameter loaded with a weight varying from 500 to 3,000 kg. for a period of 30 seconds. Dividing the applied weight by the area of the indentation gives the hardness number.

Bearing metals are used for the purpose of reducing friction and wear between parts of machinery in sliding contact. The simplest form of application of this principle of using different metals in contact is in the use of cast-iron bearings under rolled or forged wrought-iron or steel shafts. There is no tendency to heat and "seize" under moderate speeds; the friction is little, but, on account of the small difference between the metals, the wear is considerable and the use of such bearings is limited to the crudest kind of machinery. Cast-iron may then be said to be the primitive bearing metal.

In 1839 Isaac Babbitt discovered the alloy known as Babbitt's Metal which has become a standard bearing metal for use in machinery the world over. Bronze and brass came next in order of development of bearing metals. Being harder than Babbitt Metal the friction and wear are less, but the fit of the bearings must be more nearly perfect. Bronze is an alloy of copper and tin; brass is an alloy of copper and zinc, the copper preponderating in both. Phosphor bronze is a bronze to which phosphorus has been added for the purpose of cleansing and deoxidizing the metal. Most of the phosphorus passes off with the impurities and little remains in the metal. Manganese bronze is a bronze in which manganese has been used for the same purpose. Aluminum, vanadium, titanium have been used in alloys with bronze. Their effect is to add to the strength and homogeniety of the metal, but their development is in the proprietary stage.

For machinery bearings with low pressure and high speeds, under constant operation, the strength of the bronze is less important than its anti-friction and wearing qualities. For bearings of movable bridge trunnions and discs, turntable discs, and similar slow-moving parts operated infrequently and carrying heavy pressure, the bronze must be hard enough and strong enough in compression to reduce friction to a minimum and not to flow under pressure. For worms, gears, nuts, etc., the bronze must have tenacity and hardness as well as anti-friction and wear-resisting qualities. The hardness and strength of bronze increase with the amount of tin. The introduction of lead improves the wearing qualities and softens the metal besides cheaping the product. Zinc increases the tensile strength but is injurious to the alloy for bearing purposes. It should not be used except in bronze for the third purpose mentioned and then only in small quantities, as too much causes a segregation of the tin and the formation of hard "tin spots."

Until 1887 the standard bearing alloy was seven parts copper and one part tin. Some time before 1887 Dicks, of England, patented the introduction of lead and phosphorus into the copper-tin alloy, and the resulting metal became known as the "S Brand." This alloy was adopted by the Pennsylvania Railroad.

About 1876, F. J. Clamer made and sold a metal known as Ajax Metal, containing more lead and less copper than the "S" Brand. It was used largely for engine bearings. Dr. C. B. Dudley, of the Pennsylvania Railroad, began a series of experiments and tests of phosphorus and lead in bronze. He made experiments of increasing the lead and decreasing the tin, which resulted in his "Ex B Metal." G. H. Clamer experimented with increasing amounts of lead and by decreasing the tin and using only pure metals produced successfully "Plastic Bronze." This metal is suitable for light bearings and resists wear well but is too soft for bearings under heavy pressure.

The necessity for a harder bearing metal for heavy pressures has developed a series of formulas containing upwards of 20 per cent tin and no lead. The metal produced has an elastic limit in compression of from 24,000 to 40,000 lbs., and the permanent set is from 1/16 in. to 1/10 in.

A considerable number of engineers believe in specifying the physical properties only and leave the chemical composition to the maker. Others modify this course by stipulating certain control over the formula but making the physical requirements the criterion for acceptance. The third class of bronze, that requiring high tensile strength, is best secured by the introduction of from one to two per cent of zinc. This constitutes gun-metal. For this purpose the ultimate tensile strength and percentage of elongation seem to be more proper physical requirements than the compression characteristics.

There are two ways of introducing the phosphorus into the copper-tin alloy: first, by adding it direct to the molten metal; second, by the use of phosphor-tin for a part of the tin content. The first method results in the loss of a considerable part of the phosphorus. The second method gives better results and probably makes for more uniform crystallization of the tin by the phosphorus.

The so-called Manganese Bronze, being primarily a copper-zinc alloy, is not bronze, but brass. The same is true of Tensilite Bronze. These alloys are designed for tensile strength and not for bearing metals, although they are so used. Manganese bronze is considered unsuitable for high pressure bearing purposes because of its fibrous structure.

The committee submitted a report on the "Require-

ments for the Protection of Traffic on Movable Bridges," which had been prepared in connection with Committee No. 2 of the Railway Signal Association. This report was adopted for printing in the Manual, and will be found as part of the report of Committee No. 2 of the Railway Signal Association, elsewhere in this issue.

Discussion.—A. F. Robinson, of the committee, described three 100-ft. turntables on the Santa Fe.

Report on Wooden Bridges and Trestles—Committee VII

The report of committee VII on wooden bridges and trestles, of which Mr. E. A. Frink was chairman, is in effect what follows:

The committee was divided into three sub-committees, which have worked during the year on the subjects assigned. During the year a communication was received from a firm manufacturing cypress lumber, suggesting the advisability of formulating a specification for cypress bridge and trestle timber.

Sub-committee No. 1 on "Design of Docks and Wharves" submitted the following progress report for information:

A circular letter was sent to certain members of the association, who were in a position to furnish data and plans concerning the latest and best practice in the construction of freight-handling docks. Much information and many plans were received showing a great diversity of design adapted to the many varying conditions that are met on our sea-coast cities and Great Lakes ports. This is the day of permanent improvements in most of the territory covered by the railroads represented in this association, and it is pertinent to ask if it is worth while to confine investigation to strictly wooden structures.

In considering the general plan for a dock or a wharf, the character of the service to be rendered is of importance. If the structure is to accommodate passenger service, its arrangement, as to safety and convenience, should be given careful attention. If the structure is to accommodate freight service, there are even more questions arising that will have a very important bearing on the design. The character of the floating equipment is of importance.

The height of a structure is often determined by its location on a shore line, subject to rise and fall of the water due to tides or other causes. On most of our harbors conditions imposed by the general layout of government harbor lines affect the general shape of the work.

The business and economic conditions governing construction of this kind have a most important bearing. For instance, a lumber dock built in a country where the timber business will last only ten or fifteen years, will suggest a cheap first cost, while a structure to handle package or bulk freight serving ocean liners and permanent railroad lines would naturally suggest structures of permanent design. The fire hazard and insurance rate on property is very important. Often the facility of approach of the railroad tracks, complications of manufacturing and improved properties, general layout of the ground over which the approaching railroads are to be operated, may materially alter the general design.

By far the greater number of all docks yet built or being built in this country are designed with wooden piling to carry their loads. In many cases these are being surmounted above water line by concrete piers, either with or without timber grillage. Some structures are surrounded by timber sheet piling well-anchored back with steel rods and the dock then filled to the required height. The natural conditions have very important bearing on the foundation design. In soft earth piling must be long and driven until a secure bearing is found, but if the bottom is of rock formation, timber cribs designed to fit more or less the uneven rock bottom may be sunk in place and filled up to the proper level. It is becoming more and more the practice to use treated timber and treated piling in all work subject to destruction by the teredo or other form of marine borers. During the past a great many docks have been constructed of timber cribs sunk along the dock line without placing under them piling or other permanent form of support. These structures have been very unsatisfactory. Where the improvement will warrant the expenditure, the use of some form of steel sheet piling is very satisfactory. Where piling is driven in very deep water and future plans contemplate permanent filling of the dock, it is often good practice to fill in around the piling to a certain depth with rubble stone.

One of the most common causes of failure and perhaps the most common defect in dock foundation construction is the improper spacing of the supporting piling. The tendency is to space piling more or less uniformly throughout the structure with utter disregard of the unequal distribution of load. The superstructures of many docks and wharves constructed during the past few years are of a composite character. Timber, concrete and steel are used in various combinations, and there seems to be great diversity of opinion as to the best practice. In the past few years some designers have placed concrete decks on timber structures, others have used concrete with asphalt wearing surface. It would seem that either of these methods of construction were hardly satisfactory.

The superstructures of many wharves is of very simple construction, being principally a more or less extensive roof supported upon posts from the dock foundation. The danger of fires to wharves and their contents has been a factor in producing a permanent form of construction. The constant rise in prices of timber in all forms and the lower prices of steel and concrete is making it more feasible to put up fireproof structures of permanent design. Plans for proper distribution of electric current for light and power, water pipes for drinking purposes and sanitary uses and fire mains, together with fire alarm and hose storage points, are all questions to be carefully considered in designing superstructures.

Since the subject assigned viz.: comparative merits of ballast deck and reinforced concrete trestles to the committee seems to encroach on that of the masonry committee. Inquiries have been transmitted to about seventy-five of the more important railways in the United States and Canada, aggregating 225,550 miles of line. To these inquiries forty-seven of the lines have responded. The questions submitted and a very brief abstract of answers to a portion thereof appear below.

Many of the attendant questions and problems of which disposition must be made, are not susceptible of mathematical solution, and while the committee can report the work well in hand and progressing satisfactorily, though slowly, it begs a continuation of the time for work on report until next year.

During the year 1914 the committee on lag screws began the investigation of their use to fasten guard timbers to ties on wooden and metal bridges. A goodly number of replies were received to a circular which was sent to the various roads throughout the country. In a later circular one of the queries was whether the road would be willing to give lag screws a trial on

some of its bridges on the recommendation of the committee. Thirty-three roads indicated their willingness to make this trial, and the committee recommended that the trial be made. The work for this year has been to formulate plans and methods of procedure for further investigation. A plan was prepared illustrating the practice of several of the railway systems having had success in the use of lag screws. There is also shown on a plan the general ideas of the committee relative to such construction. A circular was prepared and a copy of the plan attached. This was sent to the thirty-three roads indicating their willingness to make a trial of lag screws. Replies to a later communication indicate that four roads have already begun the experiment and fourteen others expect to make the experiment soon.

In spite of the very general satisfaction expressed by the roads using lag screws, and in view of the fact that comparatively few roads have used them, and that a few of the roads using them report adversely and have abandoned their use, the committee does not yet feel justified in recommending the adoption of lag screws for fastening outer guard timbers as good practice.

The committee recommended that the report be received as a progress report and that the subject be continued for another year.

Report on Masonry—Committee VIII

The report on masonry made by committee VIII, of which Mr. F. E. Schall was chairman, summarized briefly is as follows:

The committee on masonry, during the past year, held one meeting of the whole committee. Meetings of the various sub-committees were held at different points. Sub-committees were appointed to deal with the subjects assigned by the board of directors.

The sub-committee on Cost and Method of Constructing Concrete Piles made further study of the data collected and presented a report.

The committee on Appearance, Wearing Qualities and Cost of Surface Finish of Concrete presented a final report and submitted general specifications for different surface finishes of concrete used in general railroad construction.

The committee on Design of Foundations for Piers, Abutments, Retaining Walls and Arches in Various Soils and Depth of Water, Not Considered Pneumatic Foundations, confined its activity to the searching of records as to the general practice of investigating the carrying capacity of foundation soils. A number of questions relative to the method of testing foundations in general were submitted to members of the association and others; the answers to the questions are presented in a progress report.

The Joint Committee on Specifications for Cement held several meetings during the past year.

The report of the Joint Conference, appointed to reconcile differences between the specifications of the American Society for Testing Materials and the United States Government specifications for cement, presented its report. The report was very complete. The sub-Committee on Accelerated Tests of Cement held one meeting during the past year, and decided that until such tests have received a more complete investigation the existing requirements as to constancy of volume of cement should govern.

The Joint Committee on Concrete and Reinforced Concrete held several meetings during the year, at which the members from the Masonry Committee participated.

The committee, in its progress report last year, presented typical designs for concrete piles and tables showing the cost and use of such piles. No further information being requested from the membership of the Association on this subject, the committee confined its work to further study of the data presented last year. The typical designs for concrete piles, illustrated in last year's proceedings, furnish, in the opinion of the committee, a sufficient variation to give information in regard to designs of piles that may be suitable for certain classes of work. The load which a concrete pile is to carry, the nature of the soil into which it is to be driven, whether the pile will act as a column on the hard bottom or whether the pile receives support from the soil through skin friction, are factors that enter into the question as to size, design and amount of steel reinforcement required.

The question as to whether square, octagon or hexagon shaped concrete piles should be used depends upon the style of the structure the piles are to carry; the question as to whether tapered or straight concrete piles should be used depends upon the soil in which they are to be driven, and whether the piles act as a simple column or whether skin friction may be obtained. The hexagon-shaped pile, either tapered or straight, seems to present the most suitable shape for general conditions.

Concrete piles, to obtain good results, should be seasoned not less than 30 to 40 days before handling and driving, depending upon the amount of driving expected and the season of the year when the piles are made.

Where it is not possible to drive concrete piles to plan cut-off, it is necessary to remove a portion of the pile above this point, and, unless otherwise specified, a variation of 4 in. will be allowed above the plan cut-off for the inequalities of the tops of the piles. All shaken or loosened parts of the head of cut-off piles should be removed. Where reinforcement has to be cut off it should be done by a hack-saw or oxy-acetylene torch.

The durability of a finish depends mainly upon the resistance of the surface of the concrete to the penetration of moisture. A skin of mortar is produced against the form, and the more non-absorbent the form material the richer in cement will this outside coating be, and therefore the more impervious to moisture.

The following methods are those generally used for finishing concrete surfaces. As the concrete is deposited the coarse aggregate is carefully worked back from the forms into the mass of the concrete with spades, fine stone-forks or other tools, leaving only mortar next to the forms. All holes or voids appearing after the removal of the forms should be filled with mortar made of the same proportion of cement and sand as the mortar of the concrete, and rubbed smooth and even with the surface with a wooden float.

After the forms are removed, a wash, usually of one part cement and one part sand, is applied to the surface with a brush. This fills up the pores, covers the small inequalities and wood-grain marks and produces a smooth and more even finish and color. The film of mortar thus put on usually develops checks and hair-cracks and later scales and flakes off.

The method of rubbing consists of smoothing the surface of the concrete to the desired degree of smoothness with carborundum bricks, cement bricks or with wooden floats. The rubbing smooth, fills the pores and small cavities and forms a surface of uniform finish and appearance that does not flake or scale.

The surface layer is washed with acid and scrubbed; commercial hydrochloric or nitric acids are used, di-

luted usually one part to two or three parts of water, according to the age of the concrete, as determined by experiment on the work. Great care must be taken to remove completely all traces of the acid, otherwise its action will continue and the surface be permanently discolored. Removing the mortar with sand blast has not generally proved successful, because of the varying density or hardness of ordinary concrete and consequent difficulty in removing the mortar to a uniform depth.

Concrete may be cut or dressed similar to natural stone, with a crandall, bush hammer rotary or other tools. This treatment, carried to the extent of cutting slightly into the aggregate, produces attractive surfaces, and bush hammering is considered by many to give the best possible appearance at a reasonable cost. The effect of courses can be produced by placing "V"-shaped battens, properly arranged, horizontally on the inside face of the forms.

Concrete floors do not stand hard trucking without considerable wear and dust. The wearing surface should be mortar mixed with carborundum, granite grit or other hard aggregate, and troweled hard. Some patented combinations of sal-ammoniac and finely divided iron have proved fairly durable.

Very little reliable data on the cost of the various kinds of finish have been found available. Rubbing with carborundum or wood floats, 1c. to 4c. per sq. ft.; sand blast, 2c. per sq. ft.; bush hammering or tooling, 3c. to 10c. per sq. ft.

The committee confined itself to the collection of information bearing on the methods of design of foundations as reported by various railroad companies. The bearing power of soil for the support of structures is a subject that has not been as thoroughly investigated as the determination of the strength of materials composing structures which are placed on the soil. The work of the committee embraced this difficult and lengthy problem, and it is incumbent upon every member of the American Railway Engineering Association, in making investigations and tests of the carrying capacity of soils for specific structures, to keep an accurate account of such investigations, their results and determinations, and furnish such information to the Masonry Committee.

The weight for which a foundation soil can permanently and safely be used depends upon the strength of the material encountered. The same pressure which is imposed upon the foundation soil is naturally also sustained by the underside of the material used in the construction of the foundations; therefore, the load upon the foundation soil will never exceed the strength of the building material placed upon it.

Discussion.—The main part of the discussion was the report of this committee on the subject of finishing by means of wash of cement, and most of the experiences cited by members were unfavorable to including this method in the recommendations. It was finally decided to refer the specifications back to the committee for further consideration and presentation at the next meeting.

Mr. T. L. Condron next presented to the association questions in regard to the use of steel reinforcing bars rolled from steel rails. There was some considerable difference of opinion in this discussion, as to whether or not this material was suitable for reinforcing bars, and the question was referred back to the committee, to be decided by expert knowledge and test rather than by vote of the association.

Report on Railroad Ties—Committee III

The committee III on railroad ties, of which Mr. L. A. Downs was chairman, reported substantially as follows:

The data collected shows that the practice of the railroads is anything but uniform; the fact is that the methods of properly protecting the tie are going through rapid changes, which make it difficult for the railroads to say definitely as to the effect on the tie of any particular part of the design. A study of the situation leads to the conclusion that it is one of the important problems for the maintenance engineer today. It is felt that no definite practice can be presented to the association as having been developed to such an extent that it should be adopted, and the present purpose of the committee is to illustrate tendencies of good practice and to call particular attention to the necessity of reducing or elminating, if possible, movement between the tie plate and the tie.

The primary purpose or function of the tie plate is to protect the tie from mechanical wear and all other functions should be subordinated to this. Assuming that the tie plate will be of sufficient area to properly distribute the loads imposed, and that it is of sufficient thickness so that it will not buckle, it is necessary that the movement between the plate and the tie be reduced to a minimum or eliminated, if possible. If this is not done this movement will defeat the purpose of the plate. Of the different methods in use to accomplish this the following are illustrated:

First, by using cut spikes independent of those that secure the rail, as shown in Fig. 1. Second, by using screw spikes or lag screws independent of the fastenings securing the rail. Fig. 2 shows cut spikes used to secure the rail and lag or screw spikes to secure the plate. In Fig. 3, screw spikes secure the rail while lag screws secure the plate, and in Fig. 4 the plate is secured to the tie by screw spikes, and the rail is secured by a hook on the plate on one side and by a screw or cut spike on the other. Third, by using a flat plate bolted through the tie, as is shown by the experiment illustrated in Fig. 5. Another method to reduce the movement between the tie and the plate is to provide for more or less movement between the fastenings and the rail, as shown in Fig. 3; the free distance being about 1/16-inch.

The general tendency at the present time seems to be towards a flat-bottom plate, or at least plates that have no deep ribs or projections on the bottom.

At the first meeting the year's procedure was outlined and a request made that the association secretary send a circular letter to railway companies asking for copies of their cross- and switch-tie specifications.

Specifications were received from some seventy-five railway companies, most of which sent copies of both cross- and switch-tie specifications. These were tabulated alphabetically as to the more important stipulations as reference to current practice; and used as a basis for revision of the association's cross-tie specifications, as well as a basis from which to formulate switch-tie specifications.

Information was also collected on the subject of various woods used for ties, notably Douglas fir and tamarack, with a view to criticism of lists of woods to be used treated and untreated in manufacture of ties. List of "Woods to be used untreated" and "Woods to be treated" being under discussion, it was decided to delete the terms "Walnut" and "Black Cherry" from the list, because few railway ties of these woods are now available.

"Birch" was added, because ties of this wood are available in considerable numbers for treatment.

"Pines other than longleaf, strict heart yellow pine" is inserted instead of "Loblolly, etc.," because of the multiplicity of local names of the various varieties.

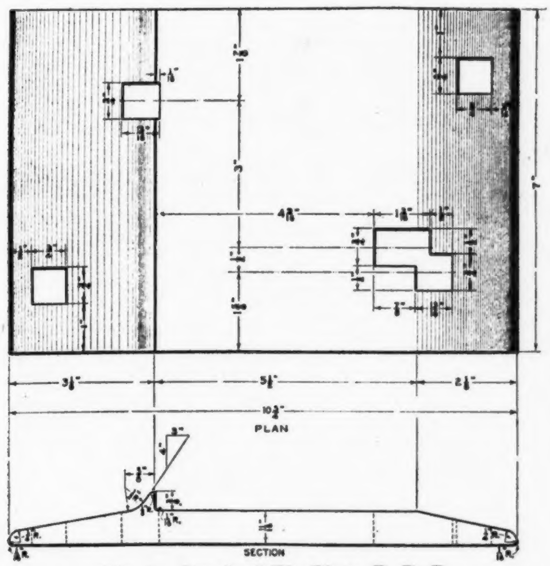


Fig. 1. Standard Tie Plate, P. R. R.

"Douglas Fir" is substituted for "Red Fir" as a better term.

There is a great deal of misunderstanding about Douglas fir, due principally to the various names it goes under in the different localities where it is found. The most common of these names and the states in which they are used are:

Douglas fir—Utah, Oregon, Colorado, Montana.

Red fir—Oregon, Washington, Idaho, Utah, Montana, Colorado.

Douglas spruce—California, Colorado, Montana.

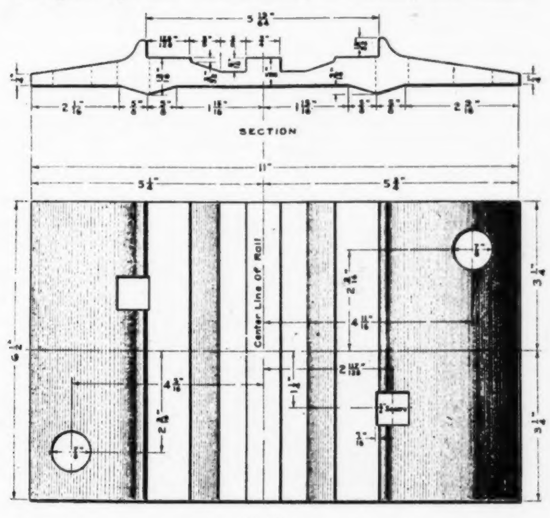


Fig. 2. Standard Tie Plate, P. L. & E.

Yellow fir—Oregon, Montana, Idaho, Washington.

Spruce—Montana.

Oregon pine—California, Washington, Oregon.

Fir—Montana.

Red pine—Utah, Colorado, Idaho.

Puget Sound pine—Washington.

The name Douglas fir has been adopted by the forest service and by various trade and technical associations and is coming into general commercial use.

The Douglas fir is in reality not of the Fir family, but is what is known as a pseudotsuga, or false hemlock, so-called on account of the resemblance its leaf stems, habits and character its cones bear to the hemlock.

The wood varies widely in character and grain, which may be very coarse, medium or fine. Coarse-grained wood is generally of a distinct reddish brown color from which it derived the name of red fir. The fine-grained wood is of a yellowish brown color, from which it derived the name of yellow fir. The botanical characters of trees furnishing these two qualities of wood are the same, and there is no foundation for the popular belief that these woods come from two different varieties or species of trees. The two grades are sometimes found in the same tree.

After investigation it is decided to leave unaltered the term "Tamarack." Though in common with all conifers the heartwood of tamarack is exceedingly refractory and practically impossible to penetrate, unless subjected to severe steaming, yet treatment of

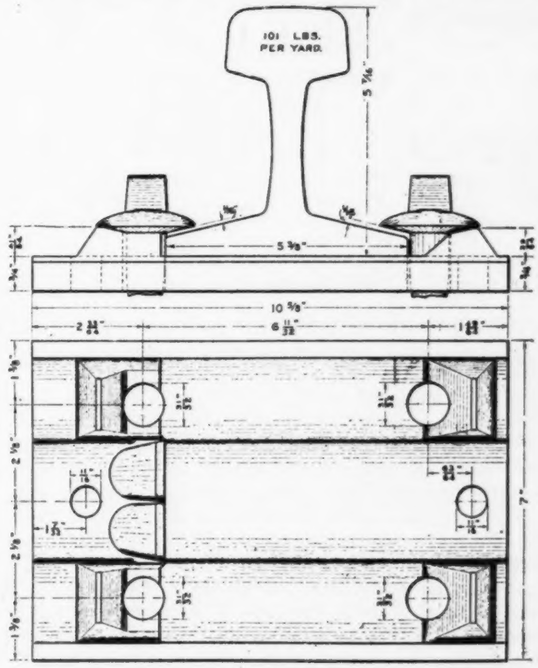


Fig. 3. Screw Spike Tie Plate, D., L. & W.

the sapwood and tie ends seems desirable, as a life of fifteen years is indicated as thus obtainable.

The term "flatted" as synonymous with "pole," as applied to the railway tie, is inserted because of its wide use by railway companies and tie contractors.

Discussion.—In the discussion, it was brought out by Mr. W. A. Courtney that longleaf strict-heart yellow pine will last about three times as long when treated with preservative as when not treated. Some data was submitted on the use of metal, composite and concrete ties, and this was accepted as information.

Report Conservation of Natural Resources—Committee XIX

The report of committee XIX was on the conservation of natural resources. A brief abstract of this paper is here presented. Mr. C. H. Fisk was chairman. The committee refers to the last two reports, partic-

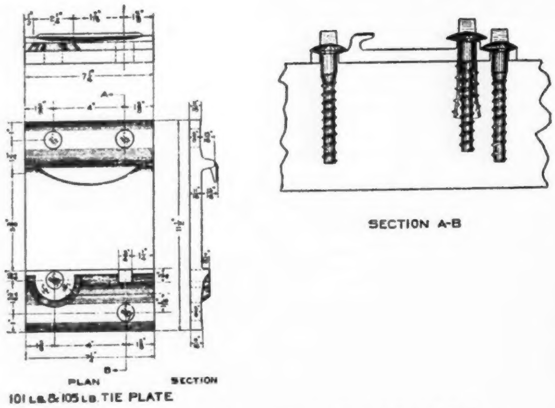
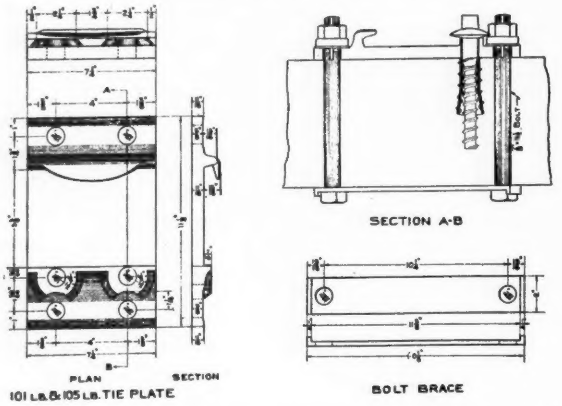


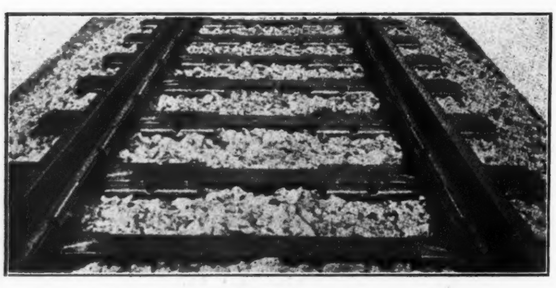
FIG. 4. HOOK SHOULDER TIE PLATE FOR 5⅜ RAIL BASE, D. L. & W. R. R.



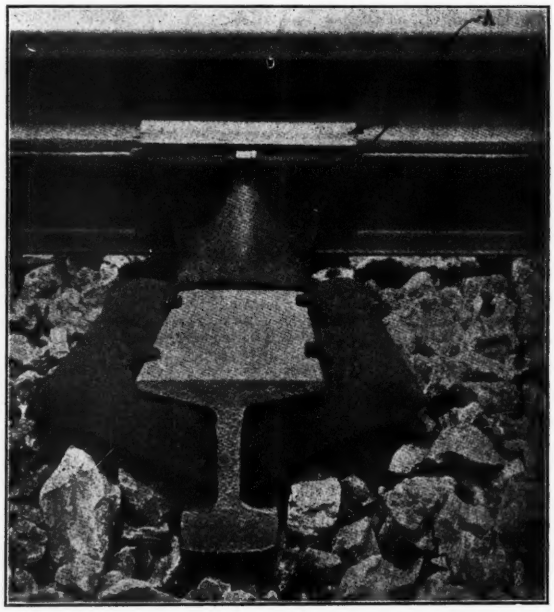
Figs. 4 and 5. Hook-Shoulder Tie Plate, D., L. & W.

ularly the 1915 report, showing success of the Illinois Central and other railways in practical forestry. Dr. B. Fernow's Canadian report deserves credit for information furnished.

Success has followed forest planting on the sand hills of Nebraska. Jack pines planted by the United States Government Forest Service ten years since now have a height of 15 ft. and a diameter of over 4 ins. The U. S. Forest Service shows that on third-quality soil, 50,000 ft. B. M. per acre of white pine can be grown in 80 years, and one-half more on best quality soil, while stumpage values actually obtained for inferior second growth average $280 per acre for 70-year-old wood, while raising the crop including all items of expense averages $140 per acre, leaving a net return of $140 from land valued at $5 per acre. Even 35 to 40-year-old wood can be profitably marketed. H. R. MacMillan, chief forester in British Columbia, reports that about 69 per cent of the area of Canada south of the sixtieth parallel is unsuited for agriculture, but a large proportion is suitable for the production of merchantable timber, and forest products will always be an important industry, as they furnish 12 per cent of the foreign trade, 16 per cent of the railway traffic and equals in value the annual wheat crop. Care of the young forest on these is not only a duty to posterity, but an insurance of timber industries affecting Canada's prosperity. The one great obstacle in the way of proper preservation of young forest growth, as well as of mature timber, is the annual recurrence of forest fires.

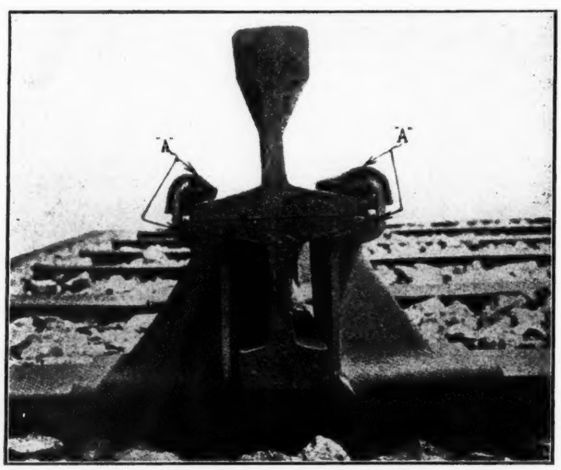


Morgan Tie in Service



Morgan Steel Tie, New Design

The U. S. Forest Service reports that an average of 10,000,000 acres is annually burned over, causing a loss of $25,000,000. These fires destroy the soil covering in a forest, causing rapid runoff on steep slopes and the erosion and irregularity of stream flow with loss of navigability, hence, the necessity of continued state and national co-operation to secure protection from forest fires, which destroy annually 12,000,000 board feet of timber. It is stated that nature has taken 10,000 years to form a foot of soil, hence, waste should be avoided by proper drainage.



Cross-Section of Running Rail Adjacent to Morgan Tie

The annual consumption is three times as great as

the annual growth, the forests are being harvested three times as fast as they grow, and this compels economy in the use of wood. Forty cu. ft. of wood per acre are used, and only twelve cu. ft. is produced by the natural growth. We use 260 ft. per capita, France 25, Great Britain 14. Dr. Swain estimates the total waste of mineral products at one million dollars daily, or more than one-sixth of the production, besides the waste of lives. The deplorable feature of this waste is its permanent loss to national resources.

Millions of dollars' worth of by-products from coke production are literally thrown away annually in the United States through the continued use of the obsolete beehive-oven process, according to reports of the United States Geological Survey. The loss by that method last year is estimated at $40,000,000. Conserve fuel as we will, fuel supplies are absolutely limited in quantity, which makes a serious problem if we depend entirely upon steam for power. Any power development, not dependent on a decreasing natural resource, must become increasingly valuable. The electric age requires cheap power to maintain its growth, so as water will always be raised by the sun, precipitated on the land and descend into the ocean; this gives the needed source of energy, 70,000,000,000,000 cu. ft. of water run off to the sea annually, enough to generate 250,000 H.P. for every foot of fall between the place of precipitation and the ocean. The commercial developable power is about 37,000,000 H.P., of which 30,000,000 H.P. are wasted.

The value of the wasted water powers in New York state has been estimated at $15,000,000 annually. The development and use of less than 25 per cent of California's available water powers would stop all wood, oil and coal-burning for power purposes in that state. The same is true for nearly all of the western states, also many of the eastern and southern states. If all the water powers could be developed and their output substituted for steam, the available coal supply could be husbanded and used for other purposes, for which there is no other equal substitute. Use of water power to furnish motive power for railways saves an equivalent amount of coal. Its conservation is then a double conservation as it involves a non-renewable resource of a limited supply, and this is of greater importance than that of any other of our material resources; if not used, water power is continually wasting with no good results.

In Canada, in 1914, the total water-power developed was approximately 1,500,000 H.P. Assuming that under average conditions 1 horsepower hour can be produced in a steam plant from three pounds of coal, this amount, calculated on a 12-hour basis and taking a load factor of 50 per cent, which is a conservative allowance, represents a saving of 4,050,000 tons of coal per year.

Electric locomotives can successfully replace the heaviest type of steam engine on mountain grade divisions of main steam roads if the daily tonnage is sufficiently heavy to justify the first cost of electrification.

The Chicago, Milwaukee & St. Paul railway has recently made elaborate tests on its Edmont grade of 1.66 per cent over the Rocky Mountains east of Butte, to show the tonnage its electric locomotives would haul and the application of regenerative braking. Two electric locomotives pulled a trailing load of 48 cars, 3,000 tons, over the range at a speed of 16 miles per hour. A steam train of 37 cars, 2,100 tons, followed, drawn by two of the heaviest road engines and a Mallet pusher at a speed of 9 miles per hour. The new locomotives pull a load thirty-eight per cent heavier than those now pulled between Butte and Anaconda, freight engines being geared to a maximum of 35 m. p. h., while passenger engines will be expected to make 65 m. p. h.; 113 miles of the proposed 440.5 miles of main track and 141 miles of side and yard tracks to be electrified have been completed, and work will continue at rate of 100 miles per year until finished.

The committee offers the above as a progress report and requests that it be received as information, and recommends continuing the study of the relation of railways to the different conservation projects, reviewing work done by each up to the present time, and to recommend such policies as may appear desirable for railways to follow.

Discussion.—The discussion of this report dealt chiefly with attempts at reforestation. L. A. Downs spoke discouragingly of the results of reforestation as practiced on railroads in this country up to date.

Report on Yards and Terminals—Committee XIV

The report of the committee on yards and terminals presented by committee XIV, of which Mr. E. B. Temple was chairman, was in substance as follows:

The section of the Manual applicable to yards and terminals was discussed in 1914, and the recommendations appear in the Bulletin for February, 1915.

The sub-committee on handling freight in double track freight houses and cost of operation of same, pursued its labors and it was suggested that consideration be also given to the advisability of constructing and operating storage warehouses in large cities in connection with inbound houses. A number of railroad companies have built and are now building some structures of this kind.

Three methods for studying the working capacity of station and approach tracks were referred to in the report for 1912, and work during the current year pertaining to passenger stations has been devoted principally to an observatioin of the results obtained by the use of two of the methods then discussed, viz., that used by the Pennsylvania in analyzing the capacity of Broad street station in Philadelphia, and the coordinate train diagram and track-occupancy diagram.

In 1910 and 1911 the track layout of the station and approaches at Broad street station, Philadelphia, of the Pennsylvania Railroad Co., were seriously congested, and a board of engineers and a transportation committee devised a method showing occupation of the tracks during the peak-load periods, also the relief afforded by the multiple-unit system of electrification. One of the lines—Broad street station to Paoli—has since been electrified. The results so far have come up to expectations.

Three classification yards were selected for study—two hump and one flat. Details of the cost and results of operation for the month of August, 1915, for the hump yards, and September, 1915, for the flat yard are available. In case members of the association desire to make further study of these costs the names of the railways operating the yards will be supplied by the secretary.

The committee has conferred with a committee of the American railway electrical engineers in reference to the question of yard lighting and track spacing in order to make typical layout plans with proper yard lighting and without dangerous side or overhead obstructions. A sub-committee has also been working on the proper grade over track scales on the hump, including the grade on each side of the scale, but no definite conclusions have as yet been reached.

Unit costs on the operation of three hump yards and

three flat, exist. They say: "If we were to rearrange and rebuild yards we would seriously consider making the classification tracks in all yards of sufficient length to hold 150 cars, which would enable us to take care of maximum trains, with a little room for expansion. This condition would be governed entirely by the trainload hauled on the division which the yard is intended to serve; the receiving tracks to hold 130 cars. This would also be governed by the trainload of the division taking the cars from the yard. In the receiving yard the grade between the receiving end and dispatching end, toward the hump, to the .50 to .75; this would enable one engine to shove the trains out of the receiving yard with considerably less damage than at present."

The committee has been working on specifications for track scales for two or three years. They submitted recomendations to show progress, stating that the American Railway Association is contemplating a revision of its "Track Scale Specifications and Rules."

Sub-committee inspected installation by the Pennsylvania railroad at East Tyrone, and were very much pleased with its action and think it has possibilities for the future.

The following recommendations concerning the Design, Construction, Maintenance and Operation of Railroad Track Scales were made with the view of setting an ultimate standard to which railroads may work, but are not intended to condemn scales, methods of installation or reinstallations now in service which come within the sensibility and tolerance prescribed. These are not intended to cover installations for special weighing, such as twin loads, etc.

The most essential features of a good track scale are the design, capacity and length, and in the selection and installation of such a scale the following must be given careful consideration:

Maximum loads to be moved over scale for weighing or otherwise, considering the spacing of and concentration of weight on axles; length of wheel base of cars or other equipment to be weighed; whether cars are to be weighed spotted or in motion; location with respect to yard work and grade; character of foundations; method of installation; drainage, lighting, heating and ventilation. In addition to this a daily test should be made on each scale equipped with an automatic attachment, by weighing a car spotted on the trip end of the scale with beam, also in motion with the automatic attachment connected. A book record of this and other tests is to be kept by weighmaster.

Efficient automatic weighing and recording devices may be used where desired. There has been in the past, and may be at present, an impression that the automatic weigher and recorder will overcome all outside influence and give correct results regardless of scale and track conditions and the speed at which the cars are handled over the scale. This is an erroneous impression and it is absolutely necessary that the scale and the automatic device be in first-class condition with properly maintained approach tracks, and cars must be run at a slow rate of speed, with particular attention to steadiness of motion, if the best results are to be obtained.

This report was accepted as a progress report.

Special Report on Uniform General Contract Forms

The special committee report, here condensed, on uniform general contract forms, was presented by Mr. H. E. Lee, chairman. Three sub-committees were formed to deal with the (1) Critical Review; (2) Industry Track Agreements; and (3) Interlocking Agreement and Railway Crossing Agreement.

Sub-committee 1 received suggestions from members, and recommended a bond, reading: The contractor shall, at the time of the execution and delivery of this contract, and before the taking effect of the same in other respects, furnish and deliver to the company, a written bond of indemnity to the amount of.......... dollars, in form and substance and with surety thereon satisfactory and acceptable to the company, to insure the faithful performance by the contractor of all the covenants and agreements on the part of the contractor contained in this contract.

This bond shall remain in force and effect for the full amount or such smaller sum as may at any time be specified by the chief engineer.

They also recommended forms for Timely Demand for Points and Instructions, Inspection, Insurance, Intoxicating Liquors Prohibited, and Annulment.

Sub-committee 2 requested members to furnish copies of agreements for industry tracks used by their companies. This request met with a gratifying response. The forms indicate widely differing conditions. Track elevation or depression and the presence of streets, buildings and other improvements greatly complicate matters. The attitude of the courts and regulating bodies further complicates conditions.

In the preparation of the form of Agreement for Industry Track submitted, the committee was guided by the majority practice of railroads. The committee felt that while the Standard Form of Agreement for Industry Tracks may not be widely adopted, it will be of value as a compilation and adaptation of what are regarded as the more important provisions required.

Sub-committee 3, on Form for Interlocking and Railway Crossing Agreement, requested members of the association to submit forms of agreement for interlocking, and for railroad crossings used by their companies. The sub-committee had been able to complete the work of tabulating and comparing these agreements, and therefore the preparation of uniform contract forms had to be held over.

Discussion.—The report of this committee was discussed at considerable length, and it was decided to refer the matter back to the committee and ask that discussion be submitted to the committee in written form for guidance in its future work.

Special Committee on Stresses in Railroad Track

The report of the special committee of which Mr. A. N. Talbot was chairman, having in charge Stresses in Railroad Track, substantially reported that the experimental work on this subject has progressed. Much effort has been expended in developing instruments for making tests. The problem is a complicated one and the difficulties in the way are many, so that satisfactory instruments for determining stresses could only be had after long and patient trials.

This was especially true concerning instruments for measuring strains in the rail under moving loads. It was important that these instruments should make a continuous record of the action of the rail under and between the wheel loads of the moving load. It was found essential that the stresses on both sides of the rail be measured simultaneously. A method of finding the depression of the track under moving load by photographic methods had to be developed. The measurement of stresses under static loads was not found to be difficult.

The field tests were conducted on the main line of the Illinois Central Railroad north of Champaign. Only the general character of these tests can be outlined. Data were taken to determine (1) the distribution of

stresses and moments along the rails for a given loading, (2) the division of vertical load among adjacent ties for a given loading, (3) the distribution of vertical pressures among the ties, through the ballast, and over the roadbed, (4) the depression, compressibility or stiffness of the track, (5) the effect of wheel spacing of some types of locomotives and also the effect of single and double concentrated loads, (6) the effect of speed upon most of the foregoing items. Tests were conducted at speeds as high as 65 m.p.h.

Among the variables of the track were three weights of rail, two sizes of ties, and three depths of ballast. In addition to tests on standard track, minor tests were made where uneven tie spacing or worn or decayed ties might affect the stresses. The Illinois Central provided the locomotives and crew. The calculation and compilation of the results required a great deal of time. The data are being put in shape and it is expected the results will soon be ready. The results appear to give fairly definite quantitative values for stresses in the rails and for the general distribution of loads and pressure under the various conditions of the test. The committee believes that it will be able to determine the general action of the track under moving loads. The committee plans to continue the tests during the coming season.

This report was presented and accepted as a progress report.

Report on Rules and Organization—Committee XII

The report of Committee XII was presented by the chairman, Mr. G. D. Brooke. A number of revisions in the Manual was presented by this committee and approved by the association.

Report on Roadway—Committee I

The report of the committee I, on roadway, of which Mr. W. M. Dawley was chairman, is substantially as follows:

In apportioning the work of the committee among the members it was decided to assign the subject to two sub-committees, on revision of Manual, including increased width of roadbed sections to provide for increased depth of ballast; the other, on steam, electric and air shovels, dragline excavating machinery and locomotive cranes, general specifications for, method of handling and blank forms used.

A circular letter requesting standard roadbed cross-sections was sent out and thirty-eight replies had been received. From an inspection of the sections so far received it does not seem that it is necessary to increase present recommended widths of roadbed to cover current practice. The ballast committee will stand by their recommendation of 24 ins. of ballast for Class A track to secure an approximately uniform distribution of load over the subgrade, and in case this depth is adopted by the association, a width of subgrade of approximately 26 ft. will be necessary to accommodate the increased spread of the ballast.

In further explanation of the subject of Haul and Overhaul discussed in last year's report, and to incorporate in the proceedings an illustrated method of determining the proper distribution of excavated material in the construction of the roadbed, the following monographs, entitled "The Profile of Quantities," by S. B. Fisher, and "The Overhaul and Distribution Diagram," by . R. W. Ambrose, were submitted.

Some further work has been done by the sub-committee looking toward a classification of soils, but the information so far obtained is not sufficient to justify the adoption of any one classification to the exclusion of others. A classification designed for identification of soils subject to pressure of engineering structures must necessarily deal with soils as found in their natural state, as in the case of the roadbed, as modified by the excavation, transportation and deposition. The object of the committee is to determine and adopt a classification which by the application of a simple field or laboratory test, preferably the former, will enable the locating or maintenance engineer to identify the soils of which it is proposed to define and limit the bearing power.

An effort has been made by the committee to co-operate with similar committees of other societies. Mr. R. A. Cummings, chairman of the soils committee of the American Society of Civil Engineers, advises that the forthcoming report of that committee contains a proposed classification for all kinds of soil and an appendix of the scientific work which is being done by the bureau of standards. Some work has been done by the joint committee on stresses in railroad tracks toward the determination of the distribution and amount of stress communicated to the roadbed through ballast of different depths, but it has not progressed far enough to enable this committee to base any conclusion as to units pressures allowable.

The sub-committee on the prevention of water pockets had on hand a large amount of correspondence not as yet thoroughly digested. It has been deemed advisable to delay drawing conclusions until the efficacy of the remedies adopted have been clearly demonstrated. The committee hopes to be able to conclude this subject next year.

The committee reported that the data it had gathered was not in shape to be presented as finished work, and its report was accepted as a progress report.

Committee II—on Ballast

The report on ballast was presented by committee II, of which Mr. H. E. Hale was chairman. The report is briefly presented in what follows:

The question of efficiency of stone ballast is largely covered and determined by the "physical tests of stone for ballast," which was thoroughly investigated by the committee several years ago and the tests which were approved by the association are specified in the manual.

The committee in its discussions has felt that the old specifications for gravel ballast, "30 to 35 per cent sand," was not sufficient and that some further specifications as to the proportion of various sizes of gravel should be made. Stretches of track have been selected where the results from the use of the ballast were known, and samples of the ballast have been tested to determine the per cent of various sizes of gravel used in the ballast.

The committee recommends that other ballast materials should be in the following order of efficiency: Stone, broken slag (not granulated), gravel, chatts, burnt clay or gumbo, cinders.

The efficiency of gravel for ballast, in the opinion of the committee is much improved by washing, because washing removes clay, dust and other undesirable materials. If the washing plant is properly arranged the desired per cent of each size of gravel can be placed in the ballast during the process of washing.

The committee obtained a very complete report made in 1913 of the Brookhaven ballast washing plant, which is a very efficient plant, and the committee was fortunate to have this report checked and revised in 1915. A copy of this report, including sketches of the general layout and detailed sketches of the method of washing, has been printed by the committee (appendix C.).

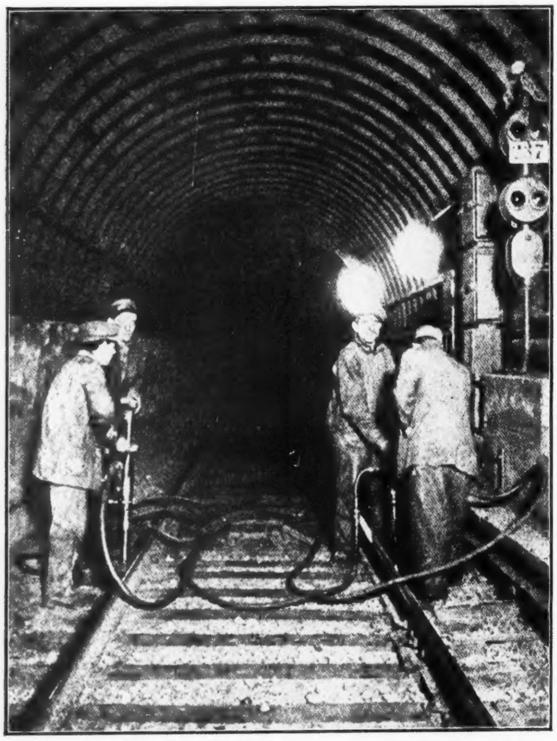
One part of particular interest in this washing plant is the method of separating the clay (appearing in considerable quantities in certain strata) from the sand and gravel without the loss of sand or gravel and permitting considerable profit from the sale of clean sand and gravel of various sizes.

In the matter of tamping the difference in cost by the mechanical tamper as reported in one of the tests is probably due to different methods of accounting, but the comparative figures taken from each test separately are of much interest.

The photographs show various views of the mechanical tampers illustrating the size of the tamper and the method of using it.

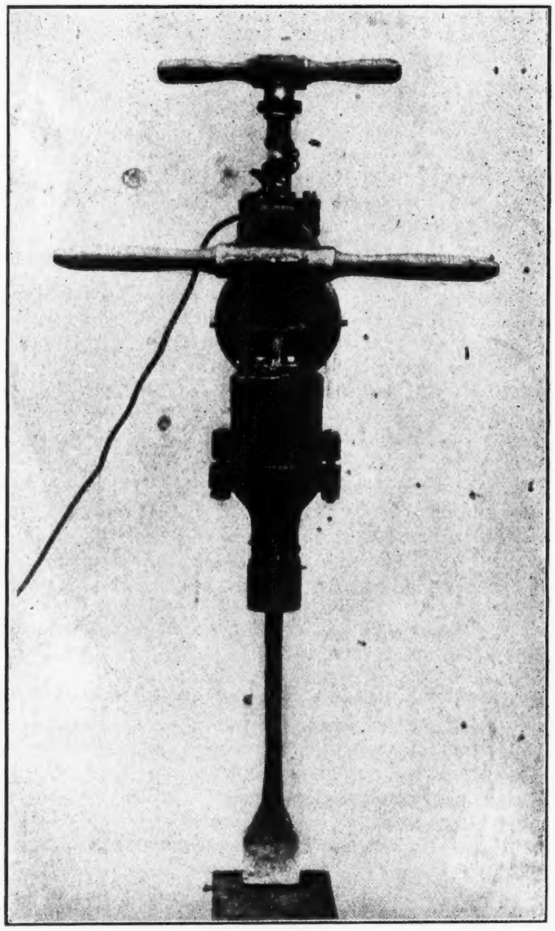
With the data now available in the tests herein the committee feels unwilling to make any definite recommendations in regard to the mechanical tie tamper, but trusts that further development and tests of the mechanical tamper will place the committee in a position to make a more detailed report and more definite recommendations.

The following is a report of the ballast formers used on the Santa Fe, together with photographs illustrating method of operating. Fig. 1 shows the devices fastened up for handling on the road. This arrangement consists of a regular ballast plow ahead of a shaping board, there being on the front end of the car a 4,000-gallon



Tamping Ties in Under-River Tubes

capacity tank. About 2,000 gals. of water is carried in this tank for weighting the car down. Just behind the shaping board there is a sprinkler pipe which is used to sprinkle the ballast. Fig. 2 shows ballast spreader and former in operation. Fig. 3 shows track skeletonized ready for dropping ballast. Fig. 4 shows track after ballast has been dropped and Cafferty-Markle device has passed over it. Fig. 5 shows the ballast after having been dressed. The appliances are handled by air. The shaping wings are raised and folded back for transporting.

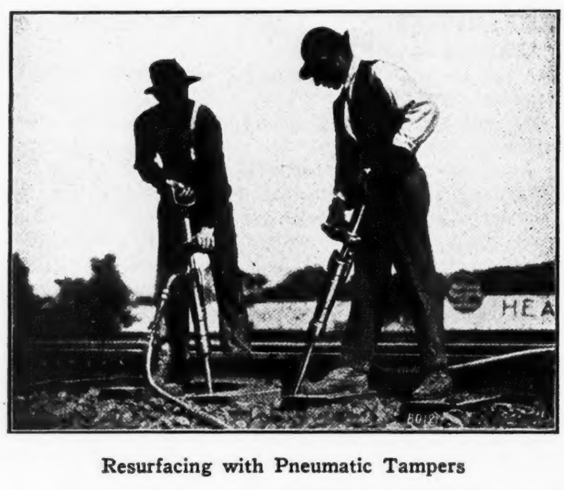


Electrically Driven Tie Tamper

The committee is of the opinion that the use of "formers" to shape the shoulder of the ballast, and also to a large extent, the path adjoining the ballast, results in considerable economy.

Ballast has been applied by contract on several roads. The Michigan Central Railroad has applied ballast by contract. The Missouri Pacific Railway in 1909 to 1911 applied quite a large amount of ballast by contract.

The committee has had considerable difficulty in obtaining good comparative figures on the cost of ballasting by railroad forces, and by contract, due to the dif-



Resurfacing with Pneumatic Tampers

ferent track and other conditions existing where ballasting has been done. They feel, however, that ballasting by contract under certain conditions has given very satisfactory results, and under certain conditions is more economical than ballasting by railroad forces.

As regards efficiency, taking into account the three classes of roads, and their experience with the depths now standard with them, the chairman of the sub-committee took up with various roads, widely distributed as to geographical location, the question as to their present practice relative to ballast depths. In nearly every case the depth of ballasting materials given for class "A" roads is at least equal to the 24 ins. recom-

Fig. 1. Ballast Spreader and Former, with Plow

mended by the committee. In several cases a much greater depth has been found.

Taking into account the tests made in the past, etc., the committee cannot do otherwise than reaffirm the conclusion that a combination of ballasting materials, approximately 24 ins. in depth in the aggregate, is necessary to insure uniform distribution of the load on the roadbed. Some roads do not require uniform distribution of the pressure; others require an almost absolutely uniform distribution in order to avoid excessive distortion. First may be cited the roadbed through a rock cut, where only sufficient ballast is necessary to

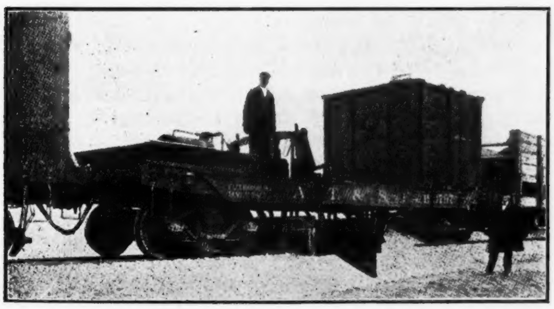


Fig. 2. Ballast Spreader and Former in Operation

provide drainage and allow of track maintenance work; second is the extremely soft clay or muck roadbed requiring the most uniform distribution possible.

Investigations now being carried on by the field parties of the division of valuation indicate that there is a much greater depth of ballast actually existing in track than has previously been supposed and that while many standard plans of trunk line railroads show 12 ins. of ballast, the actual depth existing in their main lines is much greater.

Recommendations of ballast committee, covering depth of ballast of class "A" track, should be changed to read as follows: "On fills on roadbed material, subject to deformation, by the application of live load, the minimum depth of ballast, under bottom of tie, should be 24 ins. Through rock-cuts or on material which will not be de-

Fig. 3. Track Skeletonized, Ready for Ballast

formed by application of live load, the minimum depth of ballast under bottom of tie should be 12 ins., this 12 ins. to serve as a cushion and not for the purpose of distributing the load transmitted from tie to roadbed uniformity."

Fig. 4. Track After Ballast Has Been Dropped and After Spreader Has Gone Over It

The conclusions of this committee were, after considerable discussion, accepted as information.

Report on Track—Committee V

The committee V, on track, of which Mr. J. B. Jenkins was chairman, reported substantially as follows: Meetings of the whole committee were held in Chicago as well as the meetings held by the various sub-committees. In addition to the seven subjects assigned by the Board of Direction at the beginning of the

Fig. 5. Track with Ballast After It Has Been Dressed

year, the committee was requested by the president to co-operate with Mr. Hegel of the Chicago Junction Railway in making tests of tie plates subject to action of brine drippings.

The committee has made a critical examination of the subject-matter of the chapter on track in the Manual, and considers, in view of the thorough and comprehensive revision which was made last year, that no further changes should be recommended until after the new edition of the Manual has been published.

This report is necessarily one of progress only. The work which the committee has done this year may be briefly stated as follows: It has received from eighteen railroads good data in the form of records of tests sections, which data has now extended over a period of twelve months. The sub-committee sent out a further appeal to not only the railroads which had signified their intention of co-operating, and which have kept the desired record for a year, but to a number of other roads. The sub-committee prepared a chart, outlining a suggested method of analyzing results of track sections. This chart enabled a relationship to be established between units of labor performed and the physical characteristics.

It is felt that the first step to be taken in analyzing the test section records would be to establish the values of certain physical characteristics of labor or man-hours. The next step would be the application of these results to the subject of adjusting section lengths. Out of this second subject will naturally spring a study of the situation for the purpose of establishing, on a broader basis, a method of apportioning maintenance of way expenses with reference to larger districts, special attention being given to the matter of attempting to work out values with reference to traffic and climatic conditions.

One of the railroads, represented on the sub-committee, has undertaken to make a systematic study of establishing proper lengths of sections, by making allowance for the various things which influence expenditure of labor. Certain assumptions were made in this particular instance. The application of them will certainly yield some result in the way of a more equitable distribution of labor between the various sections.

The subject assigned to sub-committee No. 3 was "Study the relation between worn flanges and worn switch points with a view to correcting the causes and decreasing the number of derailments due to the combination of worn switch points and worn flanges on wheels." The committee has been conducting some investigations since this work was assigned, and during the period up to date they have examined at least a thousand switch points, in order to determine if the proposed rule suggested by the committee last year was adaptable to the conditions, and would result in determining whether a switch point had reached the condition where it should be removed from the track. The rule as suggested was as follows:

A switch point should be removed when it is so worn that the greatest distance from the worn switch point to a straight line 24 ins. long from any point on the gauge line of the switch rail to a point on gauge line of the stock rail equals ½ in.

This rule has been applied to a number of badly worn switch points, which had reached the condition or removal. In no single case had the application of the rule indicated that it was necessary to remove these points from the track. As a matter of fact, the condition reached was that it would have been undesirable to allow these points to remain in service any longer.

An alternative rule proposed by Mr. Leighty read as follows: When the line of wear makes an angle with the gauge line projected, equal to, or greater than, "A" = ½-in., "B" = 8 in., the point shall be removed. The application of Mr. Leighty's rule works out no better than that suggested by the committee.

Generally, track conditions and certain contributary defects of equipment, not practicable to eliminate for the time being at least, must, to an undefined point, be taken into practical account in determining the limit of wear. As observed, the switch point is in a sense a fixed object, subject to frequent and easy inspection, while passing wheels are moving objects, subject to long trips over home or foreign roads, and subject also to insufficient or perhaps indifferent examination and liability of worn or sharp flanges, imperfect tram, bent axles, or stiffly rotating or rigid trucks, all of which points have a bearing upon the car safely passing over the switch point.

The M. C. B.'s rule fixes within certain limits the permissible flange wear, as well as the gauge of wheels, and the combination of a partly worn wheel and a partly worn point, with or without a modifying or contributing condition may or may not result in a derailment. It is fair to assume that generally, where a switch point approaches the limit of permissible wear, the balance of the switch lead or main track portion thereof is measurably worn, and that factor such as gauge of track, gauge of wheels, wheel centers, track centers, or rigid wheel base, wheel load, condition of loading, freedom of rotary motion of the track or trucks, curvature, superelevation, etc., tending to increase or decrease the side pressure of the flanges or the vertical loading, also contribute in assisting the wheels to mount the point. This may be further modified by the speed of the car, train or engine, the stiffness of the rail and the nature of the service the switch is supposed to perform.

In fact, there does not seem to be any theoretical basis upon which a definite rule could be established, and the practical tentative rule of a ½-in ordinate, in 24-in. chord, as the limit in any position throughout the lead along the gauge line seems sufficiently general and practical to cover ordinary conditions. On the other hand, there are ample cases where even this limit would not be permissible, and certain conditions where the limit might be safely increased. It makes a very great difference whether the switch lead is from a straight main track or from the high side, or to the low side of the curve, as well as the degree of curve and the switch angle and frog angle. Also whether switch leads from a lateral track or from a base line or yard track.

It might be safe for the service intended and generally used in a yard, but not safe for certain classes of road engines which may never be called upon to use the switch, owing to condition of curvature or clearances. In high-speed tracks no element of risk may be taken nor made, nor is economy considered, while for laterals or yard tracks under slow speed, more reasonable wear, without undue risk, may be obtained, taking consideration of the nature and frequency of the service, intricacy of track system, power employed, etc.

In the opinion of the committee that it is going to be impossible to formulate any rule that will, even in a remote sense, cover the conditions aimed at. As in the past, it is going to be necessary to rely upon the judgment of the track foreman and supervisor to determine when a switch point in a given location has

reached the point where it must be removed from the track.

The subject assigned to this committee No. 4 was "Review specifications and present designs for cut- and screw-spikes," and a circular letter was sent to roads represented in the association to ascertain the extent to which the association's specifications have been used in the purchase of the spikes, and for the further purpose of securing information as to recommended changes in the specifications and designs for both cut- and screw-spikes and data concerning dimensions and specifications of screw-spikes now in use. Two or three of the roads reporting are using the American Railway Engineering Association specification for cut-spikes.

The head of the cut-spike is designed to take the blow of the hammer directly over the axis of the spike and thus minimize the damage to spikeheads and danger of breaking the head off during very cold temperatures. The tilting downward of the nose gives a stronger, more rugged construction, and assists in giving an easier clearance in the spike machine. It also permits the pulling of the spike more readily with the clawbar. The reinforcement is symmetrical; that on the back of the neck of the spike, having been used originally as it now is with many roads to force the spike forward against the base of the rail when driving.

From the replies received from the members of the association, and from our study of the specifications for screw-spikes formerly adopted, we do not feel warranted in recommending any changes whatever in the present specifications. We submit herewith a design for a screw-spike which we believe the association will be warranted in adopting as a standard. This form of spike is now in use by two or three roads making more or less use of screw-spikes and, so far as information is available, they have given satisfactory results. The distance from the underside of the head to the beginning of the thread is variable. This distance will vary with the thickness of the tie plate and rail base.

It is well known by all concerned that the use of the screw-spike is very limited at the present time. The committee feels that now is the time to adopt a standard form of screw-spike so as to eliminate, as far as possible, the different forms of thread which are sure to be used as the use of screw-spikes becomes prevalent.

The two subjects, "Report on guard rails and flangeways and effect of increase of ⅛-in. thickness of wheel flanges," and "Continue the study of the design of manganese frogs and crossings," were assigned to a single sub-committee No. 5, for the reason that there was danger of some conflict in the requirements of the design of manganese frogs and crossings and in the flangeway requirements for thicker wheel flanges. The committee has no recommendations to make at this time excepting that these two subjects be reassigned.

The committee have designed a double switch lug. It is their opinion that with this lug, a switch may be operated safely by using either rod as a throw rod and the other as a lock rod. This lug is so designed that it will not be necessary to have rights and lefts and it will reinforce the point sufficiently to prevent locking of switch with any obstruction, of sufficient size to be dangerous, behind the point. The spacing of bolt holes for this lug corresponds to that already adopted and published in the Manual. The use of this switch lug will permit throwing the switch by either rod with equal safety and give sufficient space between to minimize trouble from snow and ice.

For the present year the sub-committee have prepared drawings of typical layouts of double crossovers or scissors for 15-ft. track centers, which were made to conform as nearly as possible with those for 13-ft. track centers. In all of the above plans the frogs, switches and turnouts already adopted have been followed as closely as possible.

For the present year the sub-committee have revised the plans of double slip crossings. The changes are in the location of the insulated joints and removing of all joints from a 10-ft. section at the center. All double-slip crossings of either design may be operated by hand or by interlocking, as may be desired. In the prepared plans they followed closely as possible the plans of frogs, switches and turnouts that have been adopted. The double lug has not been taken into consideration on these plans, as it has not been adopted, but should it be, it could be applied with a few minor changes.

The committee has compiled data of present practice as to dimensions of frog guard rails and offers a definition and specifications for frog guard rails. A rail or other device is required to guide the wheel flange so that it is kept clear of the point of frog. Rail braces may be used in place of clamps. Length of guard rail: For all new work, 11-ft. guard rails are recommended for frogs up to and including No. 10; 16½-ft. guard rails for No. 11 frogs and over.

Mr. G. W. Hegel, chief engineer, Chicago Junction Railway, advised the president of the American Railway Engineering Association that he was contemplating making a careful test of the resistance of tie plates to brine drippings and offered to co-operate with this association in making these tests. This subject was accordingly referred to the track committee, and sub-committee No. 7 was organized to co-operate with Mr. Hegel, who afterward became a member of the track committee and of this sub-committee.

The track on which the tests will be conducted is in the yards of the Chicago Junction Railway, Union Stock Yards, Chicago. This track is subjected to the almost continual movement of refrigerator cars and the resulting corrosion of track fastenings is especially severe. Preparations are now being made for the installation of tie plates of rolled steel, wrought-iron, malleable iron and American ingot iron. As the test is not primarily to determine the merits of the relative designs of tie plates, but rather of materials, only one design of each metal will be installed. With the exception of the American ingot iron plates, all tie plates are being purchased in the open market.

A certain proportion of each type of plate will be dipped in oil and will be oiled at regular intervals during the tests. Another portion will be dipped in hot tar before placing in the track, while the remainder will be inserted without preparation of any kind.

With one or two slight modifications, the conclusions recommended by the committee were adopted for publication in the Manual, with the exception of a design for a screw spike, which was criticized in the discussion and withdrawn by the committee for further consideration.

Report on Buildings—Committee VI

The committee VI report on buildings is here condensed. Mr. M. A. Long was chairman of the committee.

The only item in the Manual that was recommended to be changed was the item under "Engine Houses." The following was suggested.

"When there is an engine house without turntable and no 'Y' track or other means of turning provided,

such engine house should preferably be equipped with smoke jacks at each end of each stall."

The weighing of package freight at freight houses is very important from a revenue standpoint, and railroads are installing a greater number of scales, and giving consideration to the weighing of all package freight. There are some points where practically all the freight handled is of standard package freight, and at such houses very few scales are needed. There are three classes of freight terminals, the largest being where both inbound and outbound houses are arranged in the same layout. At such points the following arrangement of scales is recommended: In outbound houses it is desirable to have a scale at every second door opening, or a maximum of 75 ft. between scales, these to be located on the team side. In inbound houses it is desirable to have scales placed 100 ft. centers as the maximum and on the team side.

In layouts where one house handles both inbound and outbound freight and where the business is heavy and diversified, the scales should be located preferably at every third door opening, or a maximum of 75 ft. apart. Scales should be on the team side of the house.

At small outlying stations, where there is a combination baggage and freight room, one dormant scale, approximately two tons capacity, placed preferably at one side of the door nearest the team side, is recommended, as at this point it will be less liable to damage from trunks or large packages. In large houses, scale platforms should be as small as practicable to accommodate the trucks used, and usually not over 6 by 8 ft., except at certain localities, where one or two large scales are necessary to handle freight that is especially bulky. Scales for houses handling freight only should have a minimum capacity of 4 tons. Higher capacity scales cost very little more and are economical from an operating and maintenance standpoint, as they will stand up better to their work. Dial scale, properly maintained, has a great many advantages over the beam type.

The ashpit is the most expensive structure on a railroad, from a maintenance standpoint. The usual procedure at an ashpit is to drop the hot ashes into the pit and this heats up the walls and other parts of the structure. Then cold water is thrown on the ashes to cool them. This rapid cooling causes contraction in the material of the structure, and when repeated many times, weakens and sometimes destroys the structure. Another destructive element is the sulphuric acid produced by the water and sulphur in the ashes. This destroys the steel parts coming in contact with it at a rapid rate. Most ashpits are built of concrete, in which limestone is a principal ingredient. Hot ashes cause this limestone to swell and disintegrate, and in a short time the concrete is damaged. Firebrick facing has been used, but on account of the nature of the work and the tools used, experience shows that they are soon knocked off. Slag has been used in place of stone, and makes a good substitute. Gravel also makes a good substitute, and if trap rock is available, it is better than either of the above materials.

At outlying districts, where few engines are handled, cast-iron ties, approximately 12 ins. high, are used to prevent burning wood ties (Fig. 1). These should be on the spur tracks. The pit should be between the track rails, approximately 3 ft. deep (Fig. 2), and its length made to suit the business handled. In some instances these pits are fitted with buckets, which are handled by pillar crane, and a traveling or gantry crane is often used. Pit similar to that shown in Fig. 2, one side open, pit 3 ft. deep, with depressed track alongside, is shown in Fig. 3, the top of car approximately level with base of rail on the cinder track. The depressed pit filled with water (Fig. 4), into which the cinders are dropped, one feature being to design the pit so that cinders will drop directly into the water and reach the main body of the pit freely, another feature is the easy removal of the cinders by grab bucket operated either by a gantry or locomotive crane. Pit equipped with bucket or car located under the track (Fig. 5) and hoisted by mechanical means, the cinder bucket or car running on rails placed on an incline, car being run high enough to dump in a car located on a track parallel to and approximately 25 ft. centers from ash track.

All types of pits should be equipped with water supply to wet down the hot cinders. The available records are not kept in such shape that it is possible to determine the relative economy of various types of pits, but where a large number of engines are handled, the water type pit, with locomotive or gantry crane with grab bucket, is recommended.

The committee had no additional information to offer on coaling stations, the report last year being as complete as could then be made. The committee recommends this subject be continued for another year, and that they be instructed to consider the storing and handling of stored coal.

Discussion.—Recommendation of the committee that an engine-house without turntable or other means of turning an engine should preferably be equipped with smoke-jackets at each end of each stall, was adopted for publication in the Manual. The conclusions presented by the committee in regard to freight-house signals was accepted as information and referred back to the committee for further consideration.

Report on Electricity—Committee XVIII

The committee XVIII on electricity, of which Mr. Geo. W. Kittridge was chairman, reported substantially as follows:

The sub-committee on clearances brought their work up-to-date regarding overhead clearances on various electrified roads in the United States, also data regarding third rail clearance on various electrified roads.

Messrs. R. D. Coombs, G. A. Harwood and E. B. Katte have continued serving as representatives of the A. R. E. A. on the National joint committee on overhead and underground line construction. This joint committee had not yet completed its work on the revision of the crossing specifications, nor completed any other new specification.

Association delegates were actively engaged with the joint committee on preparation of the revised specifications for crossings, when the progress of the National joint committee's work was arrested by the fact that the United States Bureau of Standards was about to issue a safety code which included specifications for crossings. No definite report will be made by the National joint committee until the safety code is issued and subjected to study by the National joint committee.

Messrs. Brumley, Katte and Murray have continued as association representatives on the National joint committee on electrolysis, and report that they have no report to make to the committee on electricity until the preparation of a report by the National joint committee on electrolysis.

No meeting of the National joint committee on electrolysis was held during 1915, but sub-committees have been at work preparing various sections of the report, and it is expected the report will be ready for final check very soon.

The committee recommends that the revised data regarding overhead and third rail clearances be received as information, also the committee recommends that representatives continue to serve on the National joint committee on electrolysis and the National joint committee on overhead and underground line construction, and that the statistical data furnished by the subcommittee on clearances be kept up-to-date. The committee also recommends that during the coming year the subject of report on water power for electrical railway operation be taken up. That consideration be given any new information that may develop in reference to maintenance organization and relation to track structures, and asked for such other instructions as seem necessary or desirable.

The report of this committee was received as information and referred to the committee for further consideration.

Special Report on Grading of Lumber

The special committee on the grading of lumber, of which Dr. H. von Schrenk was chairman, in effect reported that last year they called attention to the practical difficulties of distinguishing between various species of southern yellow pine, and to the fact that it has been generally recognized that it makes little practical difference from what species of pine a structural timber is cut so long as certain density requirements are met, in addition to the usual heart and sap requirements.

During the past year, after exhaustive investigations, a rule was adopted establishing two classes of southern yellow pine, called "dense" pine and "sound" pine. By this two classes of southern yellow pine are established —dense pine and sound pine. These terms replace the botanical designations hitherto used, namely, longleaf and shortleaf pines.

In the report a series of definitions of southern yellow pine are given; also the grading of hemlock; specifications for bridge timbers to be creosoted; and proposed specifications for southern yellow pine bridge and trestle timbers to be treated, follow. In summarizing their work, the committee recommended that the definition given for quality of southern yellow pine be adopted as standard; that the grading rules for hemlock lumber, as printed in Bulletin 174, be adopted as standard, with an ommission indicated.

The definition for southern yellow pine presented by the committee was adopted. The specifications for southern yellow pine, bridge and trestle timber to be treated, was received by the association as information.

Report on Records and Accounts—Committee XI

The report of the committee XI on accounts, of which Mr. W. A. Christian was chairman, was practically as below:

The committee reports progress on use of small

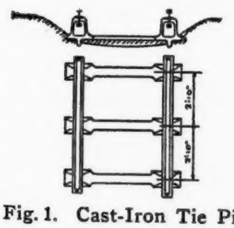


Fig. 1. Cast-Iron Tie Pit

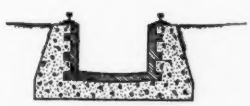


Fig. 2. Track Pit

forms on cardboard, and hopes to be able to make a report thereon next year.

Methods for Reproducing Maps and Profiles on Drawing Linen for Permanent Record and the best known reproductions of tracings are as follows: Ferro Prussiate—White line on Blue ground. Pellet—Blue lines on White ground. Ferro-gallic—Black lines on White ground. Brown—White lines on Brown ground. The photographic process. The hectograph process. The planograph process. The lithographic process.

The first four are too well known to need any explanation. The photographic process is quite varied,

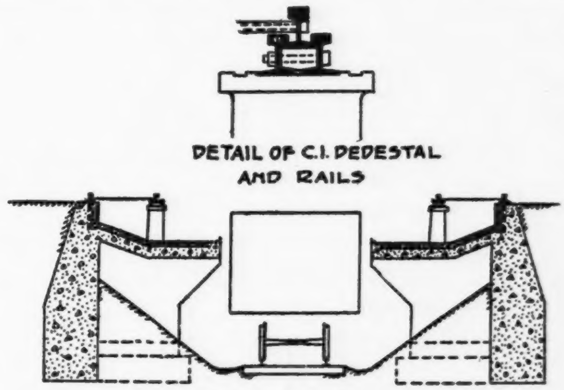


Fig. 3. Depressed Ash Car Track

but the one most generally used is where the photograph is made positive on paper without the use of the so-called negative. The hectographic process is one where the various colors of inks are used, and when applied to pads the ink being absorbed therein. The planograph process is one where the image is reproduced negatively on a coated plate and treated in chemical baths, allowing the high and low lights to stand in relief. This plate may be used in a printing

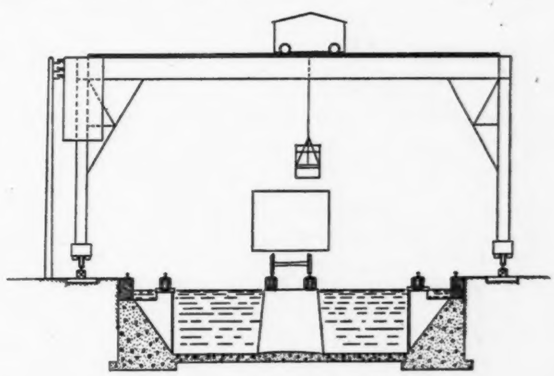


Fig. 4. Water Pit, with Gantry Crane

press. The lithographic process is the latest in this country, and on account of its cheapness it is used for the reproduction of original tracings. It being a dry process throughout, the reproductions are naturally true to scale of the original.

In explaining this latter process, it might be said that a plate of any smooth substance, such as metal, glass or linoleum, is coated with a gelatine in which are placed certain chemicals after the gelatine is melted. To apply this gelatine the plate is placed in an inclined position and covered with the gelatine. After the plate is entirely covered, it is put in a horizontal position and allowed to cool. The original tracing is put in a vacuum frame and a print is made similar to a blueprint. This print then is applied to the gelatine plate, it being removed as fast as applied. There appears on the gelatine the image of the original in dark blue lines caused by the action of the chemical of the print

and gelatine. Ink is then applied to the gelatine and adheres is proportion to the density of the lines of the original. This is the most important thing in this process. In other words, the reproductions are only good if the lines of the original are opaque. This process should be worked in a cool temperature. Reproductions by this process may be made on any material. Any portion of the original not wanted in the reproduction can be removed either on the so-called blueprint or plate. Any additions may be made in sections by making another print of same and pasting it on original blueprint before applying to pad.

Where originals, as in railroad alinement maps, are very long and wide, it is possible to reproduce these in any desired width or length. It is quite common on right-of-way sheets to reproduce the land schedules in their proper places, originals having been made on a type-writer using a black ribbon and having a black carbon reversed on the back of the original, thereby making letters opaque.

The report of this committee was submitted and received as information.

Report on Wood Preservation—Committee XVII

The report of Committee XVII on wood preservation, of which Mr. Earl Stimson was chairman, summarized

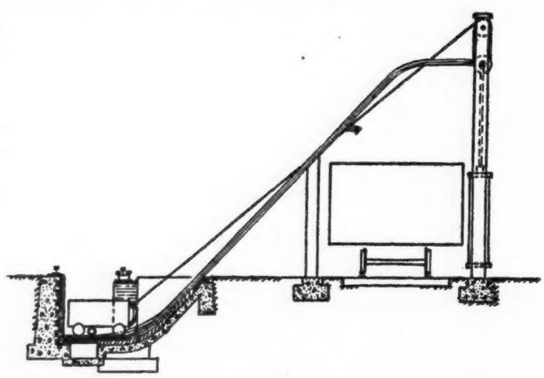


Fig. 5. Track Pit, with Bucket Power-Operated

is as follows: During the past year the committee has given attention to developing a standard method for determining the percentage of water in creosote oil when shipped in tank cars. After much consideration, the committee decided to carry on a series of tests. These tests were under the auspices of the committee with the co-operation of similar committees of the American Society for Testing Materials and the American Wood Preservers' Association.

Samples were taken by various means and afterwards divided into three sets. One set of samples was tested in the laboratory of von Schrenk and Kammerer, another in the laboratory of the Port Reading Creosoting Plant, and the third in the laboratory of the Barrett Manufacturing Company.

In accordance with the prearranged plan, one car was loaded with substantially dry oil, and a measured volume of water added to the car from a separate source, and the other car was loaded with oil containing about 7 per cent of water. The two cars each had a marked capacity of 8,043 gallons, and inside shell diameter of 82 ins. Four hundred and fifty-two gallons of water were run in by gravity from a measuring drum having an exact capacity of 113 gallons into car 4480. The water entered through a 2-in. pipe directed so that the stream of water mingled with the stream of oil.

The results obtained from car 4480, which contained dry oil to which water was deliberately added, varied widely, but on the other hand, the tests on wet oil contained in car 52 are uniform. The committee observed that the water separated rapidly from the oil in car 4480, so that indeed there was more free water on the surface of the oil within two hours after loading than there was at the time of unloading. Evidently the water and oil had become mixed during transit and the water did not again separate so rapidly from the oil. With car 52, there was no apparent separation of water and oil, even though this oil contained more water than the other. It is obvious, of course, that the partial separation of oil and water, such as took place in car 4480, makes sampling more difficult than when the water is uniformly distributed throughout the oil.

The following conclusions have been drawn by the committee: That for accurate determination of water in a tank car of creosote, a system of sampling from several zones in a car is necessary. There must be at least three zones, the top, the middle and the bottom of the car.

That the cross-section tube frequently used for taking samples from tank cars is of little value.

The so-called thief (1915 Proceedings, American Railway Engineering Association, Vol. 16, page 831) has been found incorrect in theory, and results confirm this.

That the taking of a dipper or bucket sample from the running stream cars while discharging does not give reliable results, and that this method should not be used.

That the bottle method, meaning the use of a small stoppered vessel from which the cork can be withdrawn at any desired level, is a convenient apparatus for taking zone samples.

That efforts be made to construct an improved form of the sampler, provided further tests warrant a definite recommendation for its use.

That for ordinary purposes the taking of three zone samples of the apparatus referred to or by means of a bottle device, is recommended.

That the tests described this year be considered preliminary. Care should be taken to make such tests to include both summer and winter shipments.

Regarding Tests of Treated Ties

Relation of amount of preservative and depth of penetration to resistance of the material against decay, taken as a subject, is new as regards its investigation by the committee. The value of an established relation between the amount and depth of preservatives to the resistance of the timber against decay is apparent, and this determination must be based on service tests. It was found that service records give the amount of preservative, while the depth of penetration is not recorded. Ties or timbers treated with a given amount of oil show wide variations in the depth of penetration, due to the percentage of sapwood, the moisture contents of the stick, etc.

The records of timbers that were not exposed to mechanical wear and in which the impregnated wood extends from one-half to two inches on the outside, indicate that complete penetration is not necessary if the outer protective ring remains unbroken, and the ends are likewise protected. A very definite record of creosoted ties on the Norfolk Southern in 1896 resisted decay until abrasion under the rail cut through the treated portion. Then decay commenced at the unprotected point, and necessitated the removal of many ties which otherwise were in good condition.

Records definitely show that comparatively heavy in-

jections of creosote are an absolute protection, and the point remaining to be determined is to what extent these injections can be reduced and still give protection which is in proportion to the reduced cost.

The committee presented this report to the association as information. In doing so it desired to especially call attention to the subject matter under "Water Sampling in Creosote Oil."

The report of this committee was received as a progress report.

Report on Rail—Committee IV

The report of committee IV on rail, of which Mr. J. A. Atwood was chairman, reported in substance as follows: First, as to the revision of the Manual, no recommendations were made. The main part of the report dealing with Rail Failures, Statistics and Conclusions, stated that the statistics covering rail failures for the period ending October 31, 1914, had been issued in Bulletin 179 for September, 1915. They show a decrease in the number of failures of rails rolled in successive years since 1908, as indicated by the figures showing the failures of open-hearth rails rolled by all the mills, expressed as number of failures per 10,000 tons of rail laid.

	Years of Service of Rail					
Year Rolled	0 Year	1 Year	2 Years	3 Years	4 Yerrs	5 Years
1908....	...	...	...	...	...	268.9
1909....	...	...	...	...	109.0	141.7
1910....	...	...	...	57.6	76.3	...
1911....	...	...	37.4	58.8	...	...
1912....	...	18.4	20.1	...	...	...
1913....	1.2	7.9	...	...	...	...
1914....	0.8	...	...	...	...	...

The final basis of comparison is the number of failures per 10,000 tons for five years' service, but when this age has not been reached for the later rollings, a comparison can be made in the meantime on a less number of years' service, and a study of this table indicates an improvement for the successive years' rollings as compared with the rollings of previous years.

The statistics for the year 1915 are in process of compilation. The basis of comparison has also been changed from "failures per 10,000 tons of rail laid" to "failures per 100 track miles of rail laid," and the next report will be on this basis.

In dealing with the Effect on Rails of Defective Equipment and Improper Maintenance the subject was assigned with the object of determining the effect of bad spots in wheels, on rails with a view to having the allowable defects in wheels changed if found to be necessary, and experiments in that line are being considered. The committee were unable to make any definite report until the joint committee on stresses in railroad track can go extensively into the matter of making experiments to develop what the effect of bad flat spots on wheels is on the rail.

Special Investigations of Rails for the year have been presented to the rail committee as follows:

No. 49. Segregation and Sponginess in Ladle Test Ingots. By Robert W. Hunt & Co. (Bulletin 179.)

No. 50. Influence on Rails of Method of Blooming. By M. H. Wickhorst. (Bulletin 179.)

No. 51. American Rail Mill Practice. By Sub-Committee on Mill Practice, Charles S. Churchill, Chairman. (Bulletin 183.)

No. 52. Internal Fissures in Rails. By Sub-Committee, W. C. Cushing, Chairman. (Bulletin 184.)

No. 53. Some Causes of Rail Failures. By W. C. Cushing. (Bulletin 185.)

No. 54. The Nick and Break Test in the Inspection of Steel Rails. By Robt. W. Hunt and C. W. Gennet, Jr.

The paper on Ladle Test Ingots calls attention to the importance of obtaining the test ingots free from sponginess. A spongy test ingot is apt to be of heterogeneous composition, and aluminum is suggested as a desirable addition to the test ingot to prevent sponginess.

The paper on Methods of Blooming is a study by the experimental method, of the influence of various methods of rolling the bloom, on the properties of the rails and the production of seams. A large proportion of the rail failures originate from seams in the base of the rail or from low transverse ductility in the base. This will require a great amount of experimental work, but improvement of rails in this respect can be expected to reduce rail breakages.

The paper on Rail Mill Practice covers a report of a sub-committee that visited rail mills. Brief descriptions are given of the several rail plants; representative analyses of the materials were made; comparisons of each of the stages of manufacture were instituted; attention is called to changes and improvements, and finally a discussion is given of the relation of mill practice to rail failures.

The paper on Internal Fissures in Rails covers a report of a sub-committee concerning the state of information on this subject. The different types of internal fissure are discussed. From the study of chemical examinations by the Altoona laboratory it appeared that transverse fissures occur indiscriminately in the several rails of the ingot and that segregation is not an important factor in causing the fissures.

Mr. Cushing's paper on Causes of Rail Failures presents a large number of illustrations of the different types of failures and a discussion of the causes.

The paper by Messrs. Hunt and Gennet gives the results of experience with the inspection of rails by the "nick and break test" of a rail from each ingot, and in which segregation is judged by the appearance of the fracture. It is concluded that this method of inspection insures greater protection to the purchaser and better conserves the interests of the maker.

Track Bolts and Nut Locks has had the attention of the committee, and they submitted specifications for "Medium Carbon Steel Track Bolts with Nuts," and specifications for "Quenched Carbon and Quenched Alloy Steel Track Bolts with Nuts." These specifications are recommended to supersede those in the Manual. Attention has been given to the matter of specifications for spiral spring nut locks or spring washers for track bolts.

The Manual now contains "Specifications for Heat Treated, Oil Quenched, Steel Joint Bars," which should be revised for bars made of alloy steel, and it submitted such specifications.

The report of this committee forms a part of a study of rail failures during a service period of five years, and was submitted as information and not to be acted upon this year. Specifications were submitted for a number of types of steel, which were received as information.

Report on Economics of Railway Location—Committee XVI

The report of the committee XVI on the economics of railway location, of which Mr. John G. Sullivan was chairman, made a progress report, for as was stated in the report (an abstract of which we give), the committee was not able to submit conclusions or recom-

mendations, and therefore a report of progress was put forward.

Sub-committee No. 4, under Prof. E. C. Schmidt as chairman, did some work and sent out a circular, but is not in position at present to present information from which any conclusions can be drawn. Sub-committee No. 5, under Chairman P. M. LaBach, made a study and submitted the result of freight locomotive tests on the Logansport division of the Pennsylvania lines made in 1912. This shows results for special conditions and is instructive. It was thought advisable not to publish this report now.

The chairman of the committee made a careful study of the statistics of coal consumption in freight service on the western lines of the Canadian Pacific railway for the past eight years. These studies have convinced him that instead of attempting to base coal consumption directly on the amount of work done, that it is better to divide the coal into two factors, one varying directly with the amount of work done and the other varying with the engine miles run. As a result of these studies, the following formulæ have been adopted for western lines on the Canadian Pacific railway: Single-Track Operation.—Fairly busy lines, 3.5 lbs. coal per calculated horsepower hour, plus 70 lbs. coal per engine miles run. Double-Track Operation.—3 lbs. coal per calculated horsepower hour, plus 60 lbs. coal per engine miles run.

The above figures are an average for the year, for conditions on the C. P. R. western lines, using engines equipped with superheaters and having drawbar pull varying from 36,000 to 42,000 lbs. each. The calculated horsepower is the work done overcoming resistance, lifting loads from a lower to a higher level and overcoming curve resistance. Acceleration and work done running air pumps being indeterminate, was not taken into account in the calculated horsepower hours. The amount of coal per engine miles run, covered the above mentioned work, besides coal used in keeping steam up in locomotives, or burned at sidetracks or wasted at roundhouses.

Inasmuch as no conclusions or recommendations were submitted, the report was received as a progress report.

Annual Election of Officers

The election of officers resulted as follows:
President—A. S. Baldwin, Illinois Central R. R.
Vice-President—C. A. Morse, C., R. I. & P. Ry.
Secretary—E. H. Fritch (re-elected).
Treasurer—George H. Bremner.
Directors—R. N. Begien, B. & O. R. R.; C. E. Lindsay, New York Central Lines; W. D. Pence, Interstate Commerce Commission.
Nominating Committee—A. M. Burt, Northern Pacific Ry.; A. F. Robinson, A., T. & S. F. Ry.; E. B. Temple, Pennsylvania R. R.; M. A. Long, B. & O. R. R., and W. K. Hatt, Purdue University.

Improvements on the Railroads of Argentine

Extensions of various parts of the Argentine railway system and further improvements are authorized by executive decree. A branch line from Aymogast, on the Argentine Northern, to Aming is projected, to cost $42,460. Pipe lines are to be installed at Cebollar to furnish the necessary water supply, and on the Central Northern line switching connections and signal apparatus are to be installed at Laguna River, General Pinedo and Urundel.

Concrete Freight Piers—Lehigh Valley Railroad

By M. W. LATIMER

The Lehigh Valley Railroad has just completed a freight pier at the foot of Rector street, New York, that is not only unusually well designed and equipped for the rapid handling of freight, but also is unique in being constructed of reinforced concrete. This replaces two old piers, Nos. 8 and 9, the new one being designated as Hudson River Pier No. 8. Almost two years were required to accomplish the removal of the old piers and the building of the new. A large amount of work incidental to these operations was encountered, and the total cost is reliably stated to have been more than $1,000,000. The pier is 730 ft. long and 75 ft. wide, constructed of reinforced concrete and steel and resting upon a concrete sub-structure bedded on piles. The number and spacing of the piling was designed to provide ample support for the reinforced concrete substructure and its load, and the elevation was chosen at such a height that all piling and clamping timbers would be below water line. The sub-structure consists of a series of concrete bases tied together by arches, on which are built the main supports for the deck of the pier, which is designed for a static load of 500 lbs. per sq. ft. The thickness of the concrete floor or deck is at no point less than 8 inches, and ample provision is made to allow for changes of length in such a long structure by three transverse expansion joints, covered with steel floor strips and so fitted that there is no actual connection between the abutting sections.

An unusual feature of this latest improvement to New York's water front is the massive concrete sea

Lehigh Valley Pier—West Street Front

wall running along the bulkhead of this and the adjoining pier, which, when completed, will be disignated No. 9 and will be occupied by the Central Railroad of New Jersey. This wall is constructed of solid concrete blocks resting on a pile foundation. Each block is pyramidal in shape, about 7 by 8 ft square on the base, 15 ft. high, and weighing 85 tons. The blocks were cast separately and lowered into place. It is the only concrete sea wall in or about New York City, and is likely to influence the future design of such structures to a notable degree. The operations incident to its construction and that of the pier structure involved the rebuilding of a large main sewer and the replacement of the street surface over a considerable area back of the bulkhead. The former method of building Hudson River piers was to place a number of timber cribs filled with stone back of the piling, with no protection for the original river bank; so that at periods of unusually high or spring tides the banks were over-

flowed and cellars on West Street flooded. The new pier is of solid construction, designed not only to remain rigidly fixed without the sagging so commonly observable in old works of this kind, but also capable of withstanding the ramming it occasionally must receive from tugboats and lighters. It is carried out into the river to the limit of pier-head line set by the engineers of the New York City Department of Docks.

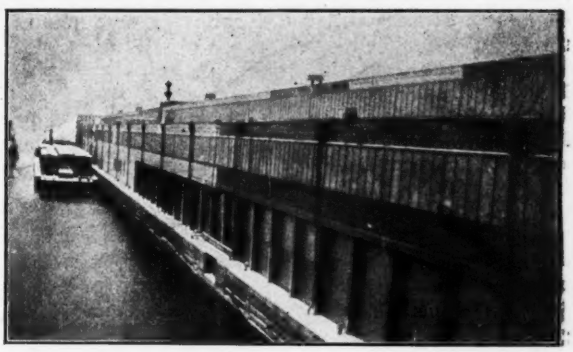
The main superstructure of this Lehigh Valley pier is a steel frame, with corrugated metal siding and steel trusses supporting a wooden roof covered with Johns-

Lehigh Valley Pier—Car Float Being Warped Alongside

Manville 4-ply built-up asbestos and felt roofing. A substantial fire wall is built across the pier at a point about half way to the end, with a metal automatic fire door of ample width. This door is hung in such a manner that it is held open by a steel wire having a fusible metal link in it over the doorway. The melting of this link by the heat of a fire starting in the vicinity of the door will release weights that in falling will pull the door to the closed position. While no sprinkler system has been installed as yet, it is the intention of the company to add this feature of fire protection to the otherwise well-protected structure. The steel work of the pier shed is independent on either side of the fire wall, so that while a destructive fire might cause complete collapse of the building on one side of the wall, it is unlikely that its effects would be felt on the other side. The sides and ends are closed by Kinnear rolling steel doors, easily opened or closed by hand, thus giving access from a boat at any point for convenient shipment. The bulkhead structure is two stories high, with the exterior of the West street facade sheathed with copper. Two driveways of ample width give acecss to the pier, and between them there is a cashier's office and a large room for the accommodation of the United States custom officials. The rest of the building will be occupied by Lehigh Valley offices, furnishing desk room for a large number of clerks. Tubular elevators communicate between this department and the cashier's office on the ground floor. On the second floor, in addition to the agent's office, toilet rooms, etc., there is a large record room built of fire-resisting materials for the storage of valuable documents. Windows are provided on both the West street and river fronts, giving plenty of light and air in any part of the offices.

On the inner end of the pier are the boiler room, meter room for water-supply main, toilet rooms and general store room. Coal for the boiler room will be delivered from boatloads at the pier directly through a window over the bins. As time spent in billing and checking outgoing freight is so vitally important, great care has been taken in the design of the arrangements of this part of the pier. Two offices are built on the driveways for the weigh-masters and their assistants. The hand-truck scale platforms are located in front of these offices, and the weights are shown on direct-reading dials about 3 ft. in diameter, enabling both the freight-handler and weigh-master to see the weight of a shipment simultaneously and within the shortest possible time, giving the man his weight check, thus facilitating the operations of loading. Platform scales are installed in several other convenient locations. There is a large fire-proof room for the storage of valuable, inflammable or explosive shipments, built as a separate unit from the main superstructure. For the convenient handling of heavy articles, there is a hand-operated traveling crane of ten tons capacity traversing the full width of the pier and capable of swinging outboard far enough to load and unload lighters.

Readiness of access to cars on floats lying at the pier has been especially considered in the general design. Numerous gangway bridges are provided on each side,



L. V. R. R. Pier—Arrow Shows Position of Fire Wall

and thus cars can be loaded or unloaded without difficulty, no matter what the stage of the tide may be. In addition to this, at the bulkhead and facing out into the stream, are three bridges for loading car-float gangways from the end, giving a total capacity of the pier of 5 floats carrying 23 cars each, or 115 cars in all.

The light from the windows in the monitor and upper part of the building is very evenly diffused, thus facilitating the rapid handling and checking of freight. This is a simple device in itself, and one that always increases the output of shops and factories.

Spring Meeting of the Railway Signal Association

Report of March 1916 Meeting

The spring meeting of the Railway Signal Association was called to order at 9:30 a. m., Monday, March 20th, in the Auditorium Hotel, by President W. J. Eck, signal and electrical engineer of the Southern Railway.

Committee No. 7, on Direct-Current Relays (chairman, E. W. Kolb), reported progress in its investigations.

Committee No. 4, on Automatic Block Signaling (W. M. Vandersluis, chairman), reported that progress had been made on specifications for trunking and other matters, and that a report would be ready for the annual meeting.

The Committee on Maintenance and Operation (G. S. Pflasterer, chairman), reported progress.

Committee on Committees of the Board of Direction (C. A. Dunham, chairman), reported on the organization and possibilities of the regional committees.

Report on Wires and Cables—Committee IX

The committee IX on wires and cables, of which Mr. W. H. Elliott was chairman, reported briefly as follows:

The committee on wires and cables presented here its report on the subjects of preparing standard definitions of principal terms used in wire and cable specifications and of preparing specifications for steel core aluminum stranded aerial wire, and asked that the matter be given consideration, with a view of having them approved at the next annual convention for submission to letter ballot. Definitions of principal terms used in wire and cable specifications. Specifications for aerial aluminum cable steel reinforced.

The definitions submitted and the illustration of the use of the terms recommended are taken from Circular No. 37, Electric Wire and Cable Terminology, of the Bureau of Standards of the Department of Commerce and Labor. These definitions were prepared by the Bureau of Standards in co-operation with representatives of the standards committee of the American Institute of Electrical Engineers, together with other engineers, representatives of railroads and manufacturers.

Of the definitions submitted, greatest variations existed in the use of the words "strand" and "cable." The word "strand" signifies a component part of a larger unit. A strand is one of the component parts of a cable, each part being either a single wire or a combination of wires.

Wire. A slender rod or filament of drawn metal.

Conductor. A wire or combination of wires not insulated from one another, suitable for carrying a single electric current.

Stranded conductor. A conductor composed of a group of wires or any combination of groups of wires.

Cable. (1) A stranded conductor (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).

Strand. One of the wires or groups of wires of any stranded conductor.

Stranded wire. A group of small wires, used as a single wire.

Cord. A small cable, very flexible and substantially insulated to withstand wear.

Concentric strand. A strand composed of a central core surrounded by one or more layers of helically laid wires or groups of wires.

Concentric-lay cable. A single-conductor cable composed of a central core surrounded by one or more layers of helically laid wires.

Rope-lay cable. A single-conductor cable composed of a central core surrounded by one or more layers of helically laid groups of wires.

N-conductor cable. A combination of N conductors insulated from one another.

N-conductor concentric cable. A cable composed of an insulated central conducting core with (N-1) tubular stranded conductors laid over it concentrically and separated by layers of insulation.

Duplex cable. Two insulated single-conductor cables twisted together.

Twin cable. Two insulated single-conductor cables laid parallel, having a common covering.

Triplex cable. Three insulated single-conductor cables twisted together.

Twisted pair. Two small insulated conductors twisted together, without a common covering.

Twin wire. Two small insulated conductors laid parallel, having a common covering.

In order to illustrate the proper use of the terms, the following discussion is submitted as information:

The use of a cable in the transmission of a single current is in general restricted to the cases where the current is large. This requires a large conductor, which for practical reasons is stranded. When one of the strands of a conductor is composed of more than one wire, each element of the strand is also called a strand. Stranded conductors are very commonly formed of concentric strands, which consist of a central core surrounded by one or more layers of helically laid wires. If used as a completed cable, such a conductor is called a concentric lay cable.

Discussion.—It was voted to accept the definitions and the principal terms used in wire and cable specifications as reported by the committee. C. C. Anthony made the suggestion that instead of printing these definitions in the Manual, a note be printed in the Manual referring to the places where these difinitions might be found in the proceedings of the association. This suggestion was accepted by the chairman of the committee. The chairman, however, submitted for adoption and submission to letter ballot specifications for aerial aluminum cable, steel reinforced. E. G. Hawkins suggested that the clause on conductivity of aluminum wire be made to read: "The conductivity of the aluminum wire shall be not less than 60% of the annealed copper, standard centigrade." This suggestion was made in order to prevent any confusion with the percentages of conductivity used in the Matthiessen standard scale. The committee accepted this suggestion, and the motion to submit to letter ballot was carried.

Report on Mechanical Interlocking—Committee II

Committee II on mechanical interlocking, of which Mr. C. J. Kelloway was chairman, reported briefly as below, giving an outline of their work, which was to prepare specifications for apparatus and materials used in mechanical interlocking; also to prepare standard plans for leadaways and layouts for slip switches, movable point frogs and derails, and specifications for apparatus and materials used in electro-mechanical inter-

locking; further as to interlocking and operation of drawbridges, and lastly, recommend methods for mechanically locking switches at interlocking plants.

The committee on mechanical interlocking presented its report on subjects—specifications for apparatus, plans, etc., for slip switches, and interlocking at drawbridges—with the request that the same be given consideration. The committee presented for discussion and acceptance revised specifications for mechanical interlocking. The committee presented for discussion and acceptance drawings of leadaways and turns in pipe lines. The chairman submitted final report, "Requirements for protection of traffic at movable bridges," which has been agreed upon by the committee appointed by the association and Committee XV of the A. R. E. A. for acceptance.

The committee is prepared to submit complete specifications for electro-mechanical interlocking. The committee has also carefully considered methods for mechanically locking switches at interlocking plants; much time and discussion has been devoted to this subject.

The committee, in presenting proposed revisions of certain sections and paragraphs in existing specifications, has, for convenience in comparison, given the proposed wording for the new schedule.

Building foundations—The foundation for interlocking station and leadout supports shall be furnished in place by the ——, and shall be in accordance with R. S. A. drawings specified. Interlocking station—When fireproof buildings are erected a special chase for electric conductors shall be provided by the erector of the buildings. Lighting for buildings—The number, kind, size and distribution of electric lights, when used, were described. Machine—Levers shall be numbered and in accordance with drawings specified.

Other items in the specification were levers, locking, cranks, rocking shafts and fittings, pipe and pipe lines, stuffing boxes, pipe carriers, compensators, jaws, lugs and pipe adjustments.

The protective appliances at drawbridges consist in devices for insuring that the bridge is in proper position, and the track in condition for the passage of trains over draw, or for reduction to a minimum of the damage in case of trains not stopping when track is not in condition for passage of same over draw; also the usual devices for protection against damage in case of derailment.

The protective devices may be classified under the headings: Interlocking power and bridge devices; bridge surfacing, aligning and fastening devices; rail-end connections; signaling and interlocking; guard rails.

Interlocking the drawbridge devices so that their movements must follow in a predetermined order to protect the drawbridge machinery.

Drawbridges should be equipped with proper mechanism to surface and align them accurately and fasten them securely in position. This condition can be secured by the use of efficient end lifts in case of swing bridges, and by proper end locks in case of lift bridges.

Rail ends may be mitered or cut square. Mitered rails where lapped should retain the full thickness of the web to the points. The points should be trailing to normal traffic where possible; on single track bridges the points should be trailing to traffic entering the movable span. Where rail ends are cut square or mitered and not lapped, they should be connected by sliding sleeve or joint bar or by easer rails to carry the wheels over the opening between the end of bridge and approach rails. If trains are to proceed over drawbridges which are in service, without first stopping, interlocking should be installed which will provide that the drawspan, tracks and switches within the limits of the plant are locked in the proper position.

This will require locking drawbridge devices; locking providing for the proper order of operation of signaling devices, such as signals, switches and derails.

This interlocking will require the following order of operation: Before opening a drawbridge—(1) display stop signals; (2) unlock rail and bridge devices. Before operating trains over drawbridge—(1) lock bridge and rail devices; (2) display clear signals.

Since there are various types and designs of drawbridges and various drawbridge devices for each of the types, and also various designs and types of signaling devices, as well as various locations from which they all may be interlocked and operated, a typical example only of the detail order of operations is given, viz., a swingbridge with all its devices operated from one location on the drawspan, having home and distant signals, derails, etc.

To open drawbridge: (1) Display stop signals; (2) unlock derails; (3) open derails; (4) uncouple interlocking connections; (5) unlock rail-end connections; (6) unlock bridge surfacing, aligning and fastening devices; (7) operate power-controlling device to position permitting application of power to bridge machinery; (8) withdraw rail-end connections; (9) withdraw bridge surfacing, aligning and fastening devices; (10) open bridge. To pass trains over drawbridge: (1) Close bridge; (2) insert bridge surfacing, aligning and fastening devices; (3) insert rail-end connections; (4) operate power-controlling device to position preventing application of power to bridge machinery; (5) lock bridge surfacing, aligning and fastening devices; (6) lock rail-end connections; (7) couple interlocking connections; (8) close derails; (9) lock derails; (10) display clear signals.

The above example of order of operation includes derailing switches, but their use is not recommended in all cases. Each situation must be given special study with respect to the use of derails, smash boards or similar devices; their location with respect to drawspan, and the use and length of guard rails.

Guard rails should be provided as for fixed bridges, except for the necessary breaks at the ends of the movable span. Obstructions to derailed wheels which are guided by the guard rails should be reduced to a minimum. The rails and attachments should be separated from the metallic structure so track circuits may be successfully operated the entire length of the bridge. The various bridge devices should be so designed that Railway Signal Association interlocking apparatus may be used. Electric and time locking apparatus is regarded as adjuncts.

Discussion.—In discussing the committee's proposition to eliminate specifications for wire-connected signals, several members questioned whether this could be done on account of the fact that a number of roads are using wire-connected distant signals. Mr. Elliott, in discussing this matter, questioned whether the added expense of maintenance of wire-connected signals did not overcome any advantage of less expensive initial installation that could be advanced. It was suggested that any road could look back in the Manual for wire-connected signal specifications when occasion arose. Mr. C. C. Anthony moved that a notation be made as to the number of roads using wire-connected signals, with the following results: 30 members stated that they are installing only pipe-connected or power-operated signals; 38 members expected to install only pipe-connected or power-operated signals in the future; 1 member stated that his road expected to continue the in-

stallation of wire-connected signals, and explained that on some branch lines only two trains a day were operated, and that in high-speed service his road expected to install only pipe-connected signals; 44 members stated that they are now using wire-connected signals to some extent, and no one stated that he was using no such signals. A number of other changes were recommended on the first two subjects reported by the committee, and these were referred to the committee to be presented at the May meeting. The committee's final report on "Requirements for Protection of Traffic at Movable Bridges" was accepted by the association.

Report on Storage Battery and Charging Equipment—Committee X

The report of committee X, of which Mr. R. B. Elsworth was chairman, was substantially as follows:

Under subject of preparing specifications for apparatus and material used in storage battery installation, the committee submitted to the association for discussion two specifications for batteries, and a drawing showing a proposed standard hydrometer and thermometer for storage battery work. These specifications have been worked up in conjunction with the manufacturers and as far as was practicable, in accordance with their suggestions.

The specifications for lead type portable storage battery have been under investigation by this committee during the past four years. Tentative specifications have been submitted to the association for discussion on two or three previous occasions. The committee have submitted specifications which eliminate the optional features which are objectionable. It is the recommendation of the committee that these specifications be discussed and if they meet with approval the committee will recommend that final action be taken.

The proposed specification for composite type stationary storage battery has also been under consideration by the committee for the past couple of years. The specification has been prepared for the use of those roads who do not wish to purchase pure lead type battery but still wish a R. S. A. specification upon which to purchase material. The committee recommends that these specifications be discussed.

A proposed standard hydrometer which has been designed and submitted by the committee with the idea of getting a substantial instrument with the largest possible scale and still be able to use the hydrometer for the smallest standard stationary storage batteries. This instrument can be purchased economically and, in the opinion of the committee, should be adopted by the association. The thermometer is of the flat type and has been marked to show the corrections to be made in hydrometer readings at the various temperatures. The committee has also been working on a combined hydrometer and thermometer, using the flat section of the hydrometer for the purpose of the thermometer scale.

The committee has also been doing work preparing plans and specifications for switchboards, and hopes to have a switchboard specification and additional plans for discussion of the association at the May meeting.

Discussion.—After some discussion, in which Mr. H. M. Beck, of the Electric Storage Battery Co., took part, it was decided to approve the specifications for opposite type stationary battery for signaling for submission at the annual meeting. The committee's plans for standard hydrometer and thermometer for portable storage batteries were received as information, as the committee wished to make some alterations before they were submitted at the May meeting.

Special Committee on Lightning Protection

The special committee on lightning protection of which Mr. E. G. Hawkins was chairman, practically reported as follows: In the matter of made ground connections, they said that ground apparatus should be designed to provide the best electrical connection with the earth, and with the lowest practicable impedance to discharges from lightning arresters, and also that it have sufficient capacity to handle discharges from the lightning arresters, and be designed with a factor of safety sufficient to insure the apparatus against damage from these discharges. It should be designed and made of the materials best suited to withstand the physical and chemical actions and be fastened as to prevent loosening and be easy of inspection. The terminal connections and ground apparatus be so aligned as to provide a direct path for the discharges.

Ground leads from lightning arresters to ground apparatus should be designed with the lowest practical impedance to discharges from lightning arresters. Ground leads have sufficient capacity and sufficient strength to withstand ordinary mechanical injuries.

Ground apparatus to be installed as near as practicable to lightning arresters, and at a sufficient depth to insure the least resistance practicable and to run as directly as practicable from the lightning arresters to the ground apparatus, and be placed where they are the least liable to injury, and so located as to provide sufficient clearance to prevent contact with operating circuits. The recommendations of the committee were accepted.

Report of Special Committee on Electrical Testing

The special committee on electrical testing, of which Mr. W. N. Manuel was chairman, reported among other things, as follows: Forty-two letters were sent out and twenty-eight replies were received. Sixteen replies indicated the practice of making systematic inspections and tests as frequently as practicable. No special methods or instructions are in use. Ten replies were brief acknowledgments.

There seems to be a growing need of frequent, periodical tests of insulation resistance, conductivity of conductors and contacts, drop-away and pick-up of electro magnetic apparatus, lightning arresters, grounds, etc. At present, only a limited number of men are capable of making such tests, and usually cover a large territory at infrequent intervals. In one instance, a relay repair car covers the system, changing out, recalibrating and repairing en route, all defective relays. An analysis of the data collected indicates the desirability of recommending the preparation of adequate instructions for making, at frequent intervals, routine inspection and tests of all apparatus and circuits, to educate maintainers along this line so they they may ultimately take necessary measurements, record the result on suitable forms. For a time such tests would necessarily be conducted under the direction of inspectors.

(a) As to methods of testing apparatus and circuits, 28 replies to 42 requests for information brought out the fact that at present comparatively few men had a right to test apparatus, and these seem in present practice to make as frequent trips over the road as possible, testing, repairing and renewing apparatus as necessary. There seems to be an opportunity for a recommendation that routine inspections and tests of

all apparatus and circuits be made at frequent intervals, with a view of educating maintainers to do this work.

(b) In regard to minimum insulation resistances allowable, the committee reported progress.

(c) In regard to ranges and scales for electrical instruments, recommendations were presented for consideration.

(d) In regard to preparing forms for recording the results of tests, a track-circuit test chart and an insulated joint test chart were presented as a progress report.

(e) In regard to specifications for adjustable resistances for testing, the committee reports progress in the development of a unit for universal use in signal testing.

(f) In regard to a standard marking or numbering of relay posts, the committee recommends the marking of binding posts on all signal apparatus, and duplicate marking of all wires connected thereto, to assure the re-establishing of proper connections when apparatus is changed out. Suitable constructive criticism was offered in the discussion, and the committee hopes to be able to present complete reports at the May meeting.

Report on Standard Designs—Committee VI

The committee VI on standard designs presented the following report which we give in a brief summary. Mr. F. P. Patenall was chairman of the committee:

The committee on standard designs presented thirteen drawings, five of which are new and eight are revisions of previous issues. On five of the eight revised drawings the changes are of such character that they do not affect the designs; these drawings were presented for the information of the members.

The revised drawings are as follows:

Signal Masts. Clamp for Base of Ground-mast Signals. Details of Transverse Pipe Carriers. Two-lever Wall Machine. Stuffing Box for Wire. Two-way Single-lamp Signal. Tang Ends with Screw Jaws. Two-lever Wall Machine, Details. Low Target Stand.

At various intervals in the past, the committee received requests and suggestions to design a switch-lamp support which would provide a separate lamp attachment at hand-operated switches where ordinary throw-over levers are used. The plan submitted meets the requirements, and provides the means of adjustment so that the rotating of the lamp to its proper angle may be kept in strict alignment.

Discussion.—The plans submitted by the committee were, after some discussion, approved. R. E. Trout reported for a sub-committee that work done had resulted in a suggestion that the number of sizes of roundels could be reduced from the present practice of 16 for red, 12 for yellow, 17 for green, 7 for purple and 7 for blue, to two standard sizes, $8\frac{3}{8}$ in. in diameter for high signals and $5\frac{3}{8}$ ins. for dwarf signals. The sub-committee further suggested that all lenses be $5\frac{3}{8}$ ins. in diameter, with the exception of the red lens of rear-end marker lamps, $6\frac{3}{8}$ ins., and rear-end platform lamps, $8\frac{3}{8}$ ins. The president announced that the matter of lenses would be discussed further at the May meeting.

Report of Special Committee on Harmonizing Specifications

The special committee on the harmonizing of specifications, of which Mr. H. S. Balliet was chairman, reported substantially as follows: After giving this subject considerable study it seemed advisable to the special committee to make the various sections, comprising the general specifications, meet all the specifications for signal installations, and in order to do this it was found necessary to revise and rearrange the existing sections, as well as to add some additional matter.

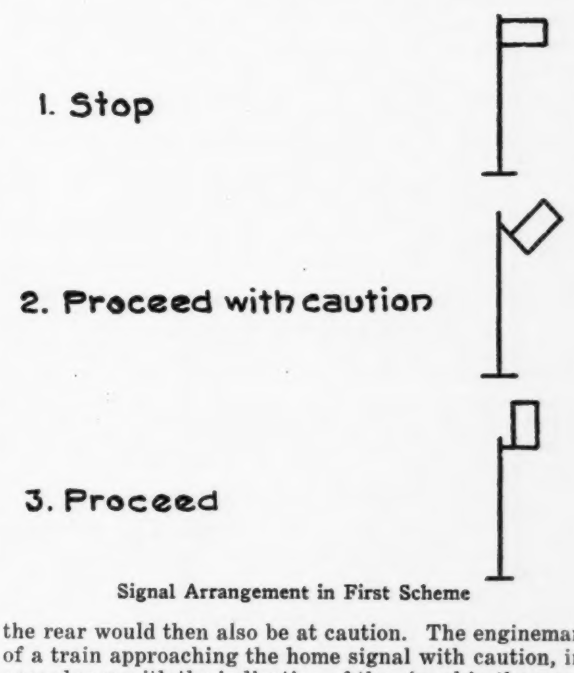
After outlining the policy of eliminating the general provisions from seven specifications, the special committee revised and rearranged the sections and paragraphs, as finally decided on by the committee.

Discussion.—The committee suggested that the matter be submitted to letter ballot. The request of this committee was received as a progress report.

Report on Signaling Practice—Committee I

The report of Committee I on the exposition of the three schemes of signaling is substantially as follows: Mr. C. C. Anthony was chairman of the committee. There were three schemes presented. To begin, Scheme No. 1 provides but one limiting indication, proceed with caution; this indication must be given when conditions are such that a train may pass the signal but, at and beyond the signal, must be run at restricted speed or so that it can be stopped at any point. In such cases any signal in the rear, operated in connection with the one in question, should also be at caution.

In the case of a home interlocking signal it is assumed that there is a distant or automatic block signal in the rear and an automatic or other advance signal stopping distance in advance. The mechanical or electrical control of the home signal would be such that it could be set at caution, but not at proceed, with any facing switch reversed. The distant or automatic signal in the rear would then also be at caution. The engineman of a train approaching the home signal with caution, in accordance with the indication of the signal in the rear, would take any action required by the conditions; and among these would be the existence, at fixed locations, of the one or more facing switches, any one of which might be reversed. The engineman, then, finding a certain route set up, might proceed at low speed over a turnout or crossover into a siding, to the main track of a branch or to a main track against the current traffic;



Signal Arrangement in First Scheme

or, if conditions required, he should move at still lower speed; or, again, if it were evident that the route set up was not the right one for his train, he should stop before getting into any difficulty. With similar effect the home and distant might be at caution for a closing-in movement of one train following another between the home and advance. On the other hand, if the advance signal were at stop, the switches set for the main track and the track clear, the home would be at caution and the distant clear.

In the case of a diverging route, operated under the permissive manual block system, it would be practically necessary to provide an advance signal, the proceed indication of which, when the block was clear, would leave a train free to proceed without signal restriction after clearing the junction or crossovers. In the absence of an advance signal the caution indication of the home signal would require a train to proceed with caution throughout the block. On a road operated under the absolute block system, however, the territory covered by a caution signal on a main track diverging beyond it might very well be defined as extending to the advance, where one exists, and through the interlocking limits where there is no advance signal. A train turning off to a branch or other main track would then be restricted until clear of the interlocking and would be free to proceed unrestrictedly through the block.

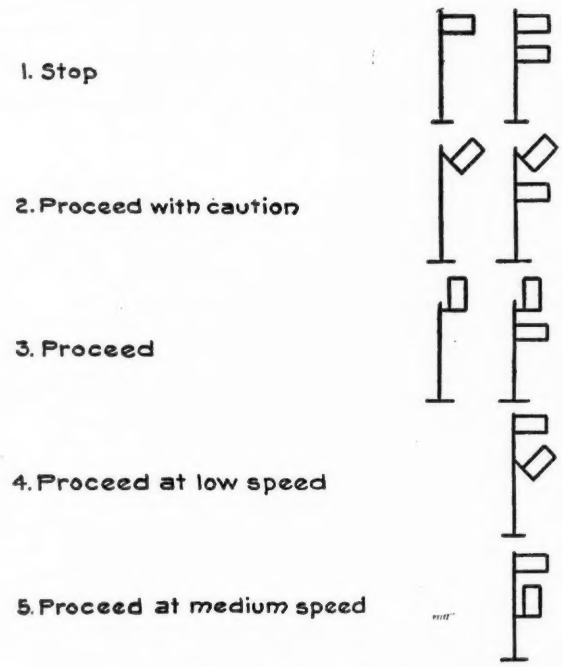
What has been said of low speed applies to Scheme No. 1, although this scheme contains no specific speed indication. The difference between Scheme No. 1 and the other schemes in this respect is that, in connection with Scheme No. 2 or Scheme No. 3, the actual rate of speed called low speed and not to be exceeded under low-speed indications, must be specified by rule; whereas, in the application of Scheme No. 1, a similar speed limit, arrived at in the same way, must be prescribed by rule as the limit not to be exceeded by a train already proceeding with caution when it passes a caution signal, unless any facing switches beyond the signal are right; or by a train moving over a turnout or crossover on the indication of a fixed signal. Under this rule, when the switches are right and other conditions are favorable, the speed may be higher so long as it is such that the train can be stopped within range of vision—as when the train is entering an occupied block with a good view or is approaching an advance signal located some distance beyond the switches. If preferred, however, the speed limit may be prescribed for all movements past caution signals by trains already proceeding with caution, to be observed even though the switches are right and equally where there are no facing switches. It would doubtless be well also to make the same speed limit apply to turnouts and crossovers, movements over which are not governed by fixed signals; this is true as well of the rate specified as low speed where either of the other schemes is applied.

In terminal territory, particularly at and near a large passenger station, and in some other similar situations, where the speed of all movements is restricted by rule to a rate at which trains may run over the turnouts and crossovers, proceed indications may be given by either dwarf or high signals for movements over the turnouts and crossovers as well as movements on the straight or continuous tracks. Where block operation, or equivalent control of the signals, is maintained through the territory, a signal should not be at proceed unless the route set up is clear and the signal in advance is at proceed, or at caution with the route beyond it clear. The caution indication should be given when the route is occupied and when the signal in advance is at stop, or at caution for a closing-in movement; also to govern movements into spur or other tracks not used by road trains. In any event a signal should not be at proceed when the signal in advance, on the route set up, gives the stop indication.

Scheme No. 2 is a development of Scheme No. 1 primarily for the purpose of providing for medium-speed movements, by an additional indication, although it includes a second additional indication, proceed at low speed, which may be used under certain conditions under which the caution indication is given in Scheme No. 1.

To illustrate applications of the low-speed indication some of the diagrams for Scheme No. 1 are referred to; it is to be understood in each case that the low-speed, instead of the caution, aspect would be displayed at the home signal.

The action required by this indication is that the train, when passing and proceeding beyond the signal,



Second Scheme Signal Arrangement

move at such low rate of speed as conditions may require but not exceeding through the low-speed territory the rate fixed by the rules as the maximum for low-speed movements. Beyond that territory the speed must continue to be governed by the conditions. Practically, then, the low-speed indication is the caution indication with a low speed limit added. Some of the uses of the indication make this quite clear.

On a road signaled in accordance with Scheme No. 2, where two-arm signals were installed the low-speed indication would be given at a home interlocking signal for movement into a siding.

When a signal gives the low-speed indication, its distant signal must be at caution. The distant signal should evidently not be at proceed, because a train might reach the low-speed signal unchecked and, as its speed could not instantly be reduced, it would pass the signal at a higher speed than that prescribed. For a similar reason the medium-speed indication should not be given at the signal in the rear. In the absence of a distant or equivalent signal all trains would have to approach as though a caution indication had been re-

ceived at a signal in the rear, as in the case of a home signal without a distant, referred to in the remarks on the caution indication. It is obvious that, under certain conditions, the caution indication is given in Scheme No. 1 to a train proceeding with caution when it approaches the signal, while, under the same conditions, the low-speed indication may be given in Scheme No. 2.

The action required by the proceed at medium speed indication is that the train, when passing and proceeding beyond the signal, move at a rate of speed not exceeding that defined by the rules as medium speed. The force of the indication is primarily to limit the speed to the prescribed rate and it goes without saying that, in a particular case, lower speed might be required by conditions having nothing to do with the signals.

As in the case of the proceed indication, clear track is not invariably a condition that must exist when the medium-speed indication is given. This indication may, for example, govern to a branch not operated under the block system. When a train is to move over a medium-speed route with a signal in advance at stop or the block occupied, or under any other conditions requiring further reduction of speed or a stop on or beyond that route, the low-speed indication may be given. A practical reason for so doing is found in the convenient operation of the signal in case conditions change so that the medium-speed indication can be given before the train arrives. The only signal operation necessary in that case is the movement of the bottom arm from the diagonal to the vertical position. The practice as to speed indications governing to an advance signal at caution, in permissive blocking and possible track-circuit control. When a signal gives the medium-speed indication the distant or equivalent signal in the rear must give the caution indication so that a train, which must not exceed medium speed when passing the medium-speed signal, will not reach that signal unchecked.

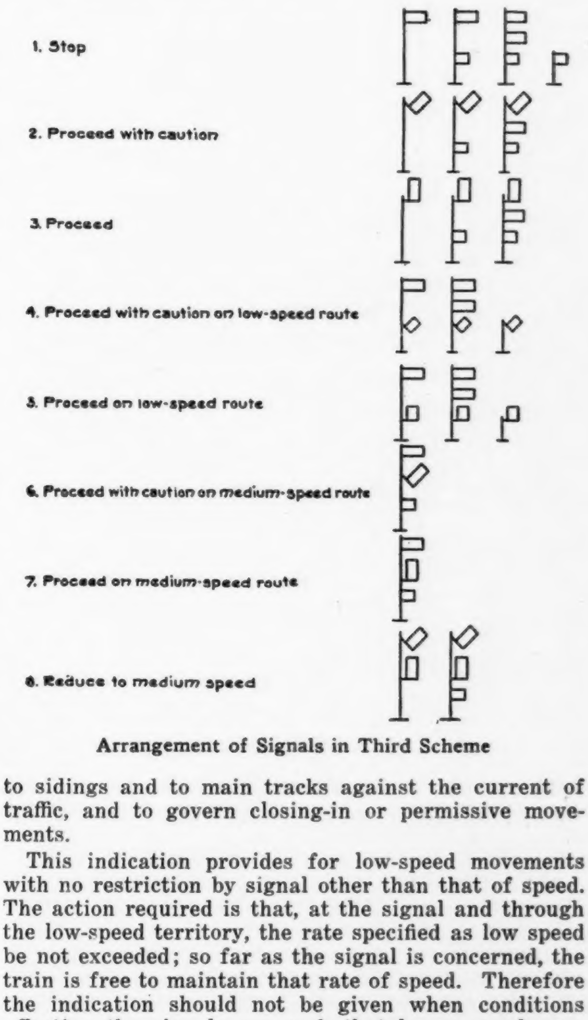
Quite frequently there is but one route for movements over which the medium-speed indication is given at a particular signal. The indication is then, practically, also a route indication.

In Scheme No. 3 four types of high signals are provided for use as circumstances may require. (1) A one-arm signal to be used, in general, where no speed indications are to be given; (2) a two-arm signal with arms of equal length at the usual spacing—7 ft. being the adopted standard of the associations—to be used, chiefly for block and distant signals, where indication No. 8, but no low-speed indication is to be given; (3) a two-arm signal with the bottom arm shorter than the top arm and at a greater distance from it than on signals of type 2, to be used where low-speed, but no medium-speed, indications are to be given; (4) a three-arm signal with the bottom arm shorter than the others, to be used where both low-speed and medium-speed indications are to be given.

Two-arm or three-arm signals may, however, be used uniformly for certain purposes, such as interlocking home signals, certain arms on individual signals being inoperative where there is no occasion to give the indications for which they provide.

In Scheme No. 3 the purpose is to provide two indications in connection with each speed, one requiring a train to proceed with caution and at the same time not exceed the specified speed; the other restricting the movement in no way except as to speed. It was found that the necessary distinction could be made and four similarly worded indications could be formulated by expressing the general restriction or absence of such restriction in the familiar terms "Proceed with caution" and "Proceed," and adding the words "on low-speed route" or "on medium-speed route," which make it clear that, where the train is to go, the speed is limited to low speed or medium speed. This wording is entirely appropriate in view of the fact that speed signal indications were developed primarily as a means of consistently signaling movements over routes differing from one another in the character of the turnouts or crossovers forming part of them, and that, in the majority of cases, the character of the route determines the speed indication to be given.

This indication is of the same effect as the low-speed indication of Scheme No. 2. It is only used, however, under part of the conditions mentioned in connection with that indication—to govern movements over low-speed routes to main tracks with the current of traffic, when conditions do not permit the indication, proceed on low-speed route, to be given; to govern movements



Arrangement of Signals in Third Scheme

to sidings and to main tracks against the current of traffic, and to govern closing-in or permissive movements.

This indication provides for low-speed movements with no restriction by signal other than that of speed. The action required is that, at the signal and through the low-speed territory, the rate specified as low speed be not exceeded; so far as the signal is concerned, the train is free to maintain that rate of speed. Therefore the indication should not be given when conditions affecting the signals are such that lower speed or a stop may be necessary; as when the track beyond the signal is occupied or a signal in advance is at stop. Under this indication the speed may be increased as soon as the train is through the territory covered by the indication. When a signal gives either of the low-speed route indications, the distant or equivalent signal in the rear, if there is one, should be at caution.

The action required by this indication is that the train, while not exceeding medium speed through the territory covered by the speed indication, proceed with caution through the territory covered by a caution indication on the track reached by the medium-speed

route. The train may pass the signal at, but not above, medium speed if the conditions permit such speed under the caution indication.

This indication is of exactly the same effect and is to be given under the same conditions as the medium-speed indication in Scheme No. 2. It may govern to a signal in advance giving the indication proceed with caution on medium-speed route, when the conditions beyond are such that a train may maintain medium speed up to that signal.

The action required by this indication is that the speed of the train, if it is higher than medium speed, be reduced to that speed after the signal is passed and at least by the time the next signal is reached if the distance between signals is sufficient. Ordinarily the indication is given as a "medium-speed distant indication" when the signal in advance is giving one of the medium-speed route indications. Under these circumstances the distance between the signal giving the reduce-speed indication and the one giving the medium-speed route indication, should be sufficient for the speed of the fastest train to be reduced to the specified rate. Occasionally three successive signals must be so spaced that there is not sufficient distance for reduction to medium speed between the second and third nor between the first and second, although the distance between the first and third is sufficient. In that case, when the third signal gives a medium-speed route indication, the reduced-speed indication must be given at the first and should be repeated at the second.

Where the lengths of automatic blocks or the distances between several successive semi-automatic signals are less than stopping distance for the fastest trains, the reduce-speed indication may be given at one signal when the next is at caution and the signal beyond that is at stop. Then a fast train, reducing speed after passing the first signal and passing the second at approximately medium speed, can readily be stopped at the third; while a slow train may continue at its moderate speed from the first signal to the second and make its entire reduction of speed to a stop at the third signal after passing the second. When an automatic block signal is provided with two arms, so that the reduced-speed indication can be given, the diagonal arrangement of lights, distinguishing the signal as an automatic, S8, may be secured by the use of a spectacle of design A on the top arm and one of design B on the bottom arm. The red marker light then becomes an active light; when the bottom arm is vertical its green light appears at the left of the mast. However, the diagonal arrangement of the two lights at that time is of no significance.

Discussion.—The report of the committee was accepted, with a unanimous vote of thanks to Mr. Anthony for the preparations of the exhibition.

Committee No. 3, on Power Interlocking, did not present its report on account of the absence of the chairman, Mr. F. B. Wiegand. The report was held over for discussion at the May meeting.

There were registered 159 active members of the association, 14 junior members, and 59 associate members.

The officers of the Railway Signal Association for 1916 are:

President—W. J. Eck, signal and electric engineer, Southern Ry., Washington, D. C.

Vice-Presidents—Charles A. Dunham, signal engineer, Great Northern Ry., St. Paul, Minn.; and W. H. Elliott, signal engineer, New York Central Lines, Albany, N. Y.

Secretary-Treasurer—C. C. Rosenberg, Bethlehem, Pa.

Directors—T. S. Stevens, F. P. Patenall, B. H. Mann, F. B. Wiegand, J. C. Mill, M. M. Vanderslius, A. H. Yocum, W. M. Manuel, Charles W. Parker, J. M. Waldron, C. J. Kelloway.

Government Railways in Japan

Interesting Information Regarding Operations, Wages and General Conditions

U. S. Consul M. D. Kirjassoff, Yokohama, makes a highly interesting report on the Japanese railways to the Bureau of Commerce at Washington. The report covers operations for the year ending March 31, 1915. Conditions required the exercise of economy in that year, resulting in a reduction of the number of shops and the number of employes. The total capital of the Government Railways expressed in our money for the ber of employes totaled 114,966. The total route mile-year 1914-15 was $501,477,698, an increase over the previous year of more than $16,000,000, while the num-age of the entire system is 5,686, and the track mileage amounts to 8,611. 75 new stations were constructed in 1915, making the full number of stations 1,604. 2,611 locomotives were in service, 43,702 freight cars and 6,693 passenger cars and 47 ships with a gross tonnage of 21,515. The number of passengers carried was 166,092,421. The profits for the year amounted to $27,385,682. The average wages paid per day per capita was in round figures but 36 cents. The total traffic receipts were $55,860,469, and the ratio of expenses to gross receipts was less than 50 per cent. Conditions in Japan are materially different from those prevailing in the United States, but the operations of the Japanese railways are attended by the exercise of well-directed economy.

Bascule Bridge for the Southern Pacific

Preliminary steps to abolish the old swing bridges across Oakland's inner harbor from Oakland to Alameda have been taken by the chambers of commerce of Oakland, Berkeley and Alameda and by the city councils of the three municipalities. The authorities are seriously considering the erection of bridges of the bascule type to care for the rapidly increasing traffic over the present bridges and which also will do away with the slow-moving swings that are now a great hindrance to the water traffic in the inner harbor.

At present there are two swing bridges, one used exclusively for the Southern Pacific suburban and the other caring for all other traffic, including trolleys. The time required to open the swings not only causes long delays in street traffic, but also holds up the shipping to so great an extent that vessel men say they are a menace to navigation.

The Delaware & Hudson

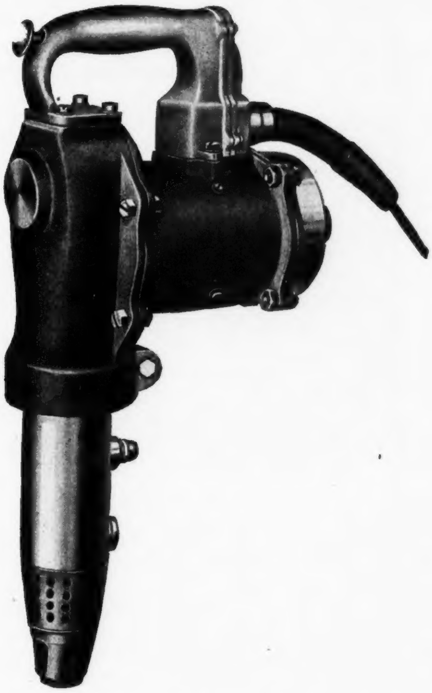
In spite of the general business depression which prevailed in the year 1915, the Delaware & Hudson Company made the following showing for the period ending December 31, last, covering its railroad department: Total operating revenue, $23,787,519; total expenses (operating), $14,823,625.67; net revenues, $8,963,893.33. This was a net increase, over the previous year, of $1,429,782.70, while the operating expenses decreased 4.52 per cent, making the percentage of expenses to earnings, 62.32 in 1915 as against 66.84 in 1914.

The yearly dividend of 9 per cent was continued.

New Methods and Appliances

Duntley Universal Electric Hammer Drill

The Chicago Pneumatic Tool Co., Chicago, Ill., have recently placed on the market an electric hammer drill for drilling stone and concrete. The tool is equipped with a universal motor, and will operate interchangeably on direct or alternating current. The hammer blow, which is delivered by a piston on the drill steel or chisel, is produced by pneumatic impact and is very effective. At the instant the blow is struck the piston is running free of all mechanical parts, and therefore no shock or vibration is transmitted to the electrical parts of the tool. This means that there is no tendency for the electrical wires or connection to be crystallized due to incessant jarring. The tool is well balanced, and when held loosely in the hand the line of the center of gravity falls between the third and middle fingers of the hand, and lies within the barrel of the tool, allowing



Electric Hammer Drill

the tool to hang vertically. A thumb-switch conveniently located in the handle for the control of the electric circuit is manipulated the same as in the well-known pneumatic hammers. All bearings are of the ball type, provision being made for the lubrication of all revolving and reciprocating parts. The gears and those portions of the moving parts subject to wear are all hardened. When drilling holes in stone or concrete in a downward position the powdered cuttings collect rapidly and not only absorb and waste much of the force of the blow, but tend to choke up the hole, making it difficult to remove the drill bit. A special feature of the Duntley electric hammer drill is the live air device for clearing the hole of the cuttings while drilling. This makes it possible not only to deliver the full force of the blow on the solid stone or concrete, but the removal of the drill bit is accomplished without difficulty, as there are no cuttings left in the hole to interfere. Hollow steels for this purpose can be furnished.

Right-of-Way Gates

The Iowa Gate Co., Cedar Falls, Iowa, have recently adapted to right-of-way use some of the features of construction that have made their gates for other pur-

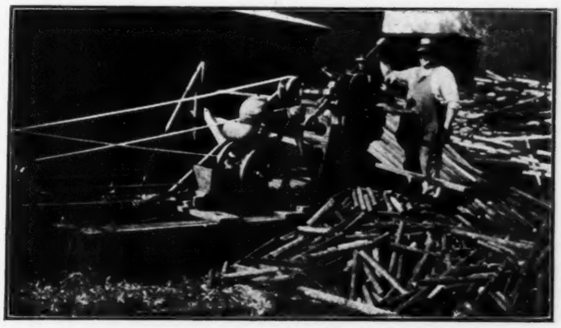


Fig. 1. Locomotive Boiler Flues as Received from Railroads and the Machine for Cutting Them

poses efficient and economical. The most important feature of these gates is the use of 2 or 2¼-in. rejected locomotive flues in place of new tubing.

It has been found by experiment that rejected locomotive flues of this size are equal in strength for this purpose to tubing of 1⅝-in. outside diameter. The tubes are received from railroad companies in even lengths as they are taken from service, and Fig. 1

Fig. 2. Locomotive Boiler Flues Cut to Proper Length and Stocked

shows the portable pipe-cutting outfit which is used to saw the tubes of lengths used in making the gates. Before this operation, the tubes are rumbled, and after they have been trimmed to stock length they are stored as shown in Fig. 2. After the gates are fabricated they are stocked in standard sizes, and shipment can be made on very short notice. In Fig. 3 is shown a stock

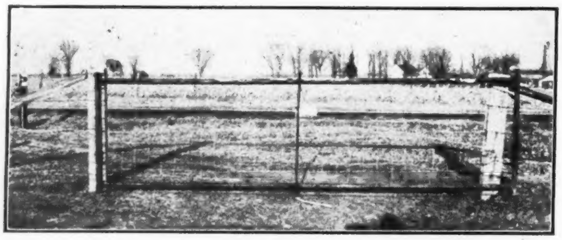


Fig. 3. Gate, in Right-of-Way Fence, Made of Locomotive Boiler-Flue Frame and Woven Wire

gate in right-of-way fence, Chicago, Rock Island & Pacific tracks, near Cedar Falls, Ia.

The use of rejected locomotive boiler flues makes possible a saving to the railroads of about one-third the cost of the gates. Another feature of advantage, illustrated in Fig. 4, is the adjustability of the style "H" gate, which can be raised on uneven ground to prevent dragging.

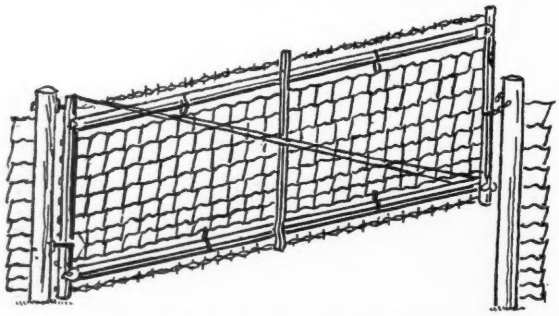


Fig. 4. Adjustable Feature of Gate for Sloping or Uneven Ground

New Trade Literature

The Anchor Co., Railway Exchange Bldg., Chicago, Ill., have recently issued a 12-page illustrated booklet on the Efficiency One-Piece Rail-Anchor, which employs a 1/4-in. cotter pin through the anchor and the neutral axis web of the rail to secure a positive grip.

The Anchor Post Iron Works, 165 Broadway, New York City, have recently issued an 8-page catalog on Anchor Post Railroad Fences, which are suitable for inter-track or right-of-way fencing. One of the features of this fencing is the method of securing pickets to rails by means of an electric weld.

The A. S. Cameron Steam Pump Works, New York City, have recently issued a 36-page illustrated bulletin, No. 110, describing their line of duplex pumps. The bulletin describes the details of the design and construction of the pumps as well as the complete line of machines, and includes tables of capacities and instructions for installing and maintaining.

Franklin Railway Supply Co., New York City, have recently issued a 24-page illustrated catalogue on McLaughin Flexible Conduit, Franklin Bolt Joints and the Franklin Single Water Joint. The catalogue illustrates by photographs and sections the construction, application and repaired parts of the devices named.

The Tyler Underground Heating System, Pittsburgh, Pa., has recently issued a large sheet containing 61 diagrams, cross sections and tables, describing in detail the Tyler specialties for use on ditch and tunnel piping for every purpose, also the Tyler boiler feed water weighing machines, meters and traps. The information condensed on this sheet is the equivalent of a volume of considerable bulk and gives in compact form a tremendous amount of data for the use of engineers in laying out ditch and tunnel piping.

Supply Trade Notes

Walter H. Bentley has recently been appointed assistant to Burton W. Mudge, president of Mudge & Co., Chicago, Ill. Mr. Bentley entered the service of the Chicago & Northwestern Railway in 1903, in the storekeeping department. In 1909 he served for a time as locomotive fireman on the Duluth & Iron Range, returning to the Chicago & Northwestern, where he filled various positions in the engineering and purchasing departments. In 1912 he joined the Chicago sales force of the Baldwin Locomotive Works, and the Standard Steel Works, and in 1914 was appointed western representative of the Curtain Supply Co., of Chicago, where he remained until the announcement of his recent connection with Mudge & Co.

Walter H. Bentley

The Russell Engineering Co., St. Louis, Mo., has recently announced the resignation of F. G. Curfman from their staff and the addition to their sales force of C. H. Fritsch, who has had 15 years' experience in gas bench construction work.

W. G. Willcoxson has severed his connection with the Garrett-Callahan Co. and accepted a position with the Boss Nut Co. of Chicago.

If you entertain the supposition that any real success, in great things or in small, ever was or could be . . . wrested from Fortune by fits and starts, leave that wrong idea here.—Mr. Jarndyce.

Personal Items for Railroad Men

Lee Barnes, recently appointed acting roadmaster for the Northern Pacific Ry. at Little Falls, Minn., succeeds Austin Grimes, roadmaster.

J. E. Bishop, recently appointed foreman of section P-1 of the Pittsburgh and Lake Erie at Pittsburgh, Pa., has been serving in a similar capacity on the Pennslvania lines east of Pittsburgh.

B. M. Cheney, recently appointed general inspector of permanent way and structures of the Chicago, Burlington & Quincy at Chicago, entered the service of the Burlington, Cedar Rapids & Northern in 1900 as rodman on location. In 1902 he was appointed resident engineer of the Des Moines, Iowa Falls & Northern. In 1903 he joined the forces of the Illinois Central and in 1904 he was appointed assistant engineer and later assistant chief engineer on construction of the Inter-Urban Railway at Des Moines, Ia. In 1906 he was appointed assistant engineer on construction and maintenance for the Chicago, Burlington & Quincy and in 1914 he was appointed assistant to the general inspector of permanent way and structures, serving in this capacity until his recent appointment.

A. Crumpton has recently been appointed assistant valuation engineer on the Grand Trunk Railway System at Montreal, Can.

Charles H. Ewing, recently appointed general manager of the Philadelphia & Reading Ry., at Philadelphia, succeeding Agnew T. Dice, entered the service of that road in 1883 as rodman in the engineering corps. In 1885 he was made transitman, and in 1886 assistant enigneer on construction and maintenance; in 1889 he was appointed roadmaster, and in 1892 division engineer. In 1893 he was appointed chief engineer of the Central New England Ry., and in 1902 returned to the Philadelphia & Reading as division engineer on the Reading and Lebanon divisions, and in 1905 was appointed engineer of maintenance of way. In 1910 Mr. Ewing was made superintendent of the Atlantic City R. R., and in 1913 he was appointed general superintendent of the Philadelphia & Reading, where he remained until his recent appointment as general manager.

Samuel Fisher, recently appointed general foreman of track on the Pittsburgh & Lake Erie, succeeding E. J. Laughlin, has been foreman of section P-1 at Pittsburgh, Pa.

J. E. Kissell, recently appointed acting engineer of maintenance of the Peoria & Eastern, succeeds A. M. Turner, assigned to other duties.

E. J. Laughlin, recently appointed supervisor of track for the Claiston Steel Works at Claiston, Pa., has been for the past 17 years on the Pittsburgh & Lake Erie, where he has resigned the position of general foreman of track.

B. W. Lee, recently appointed engineer of the Aransas Harbor Terminal Ry., at Aransas Pass, Tex., entered the service of that road in 1913 as draughtsman, and was shortly made assistant engineer. His appointment as engineer followed the death of J. C. Moore, vice-president and chief engineer of that road.

E. H. McGovern has recently been appointed resident engineer for the Cleveland, Cincinnati, Chicago & St. Louis Ry. at Columbus, Ohio.

W. J. Mahoney, recently appointed acting supervisor of bridges and buildings on the Louisville & Nashville at Etowah, Tenn., is serving during the absence on account of sickness of S. Long. Mr. Mahoney has been bridge foreman on that division since 1905.

B. D. Marburger, recently appointed roadmaster of division No. 6 of the San Antonio & Aransas Pass Ry., began railroad work in 1905 on the Sunset Central lines and after two years' work as a student, which included some experience as draughtsman, instrumentman and timekeeper, he was transferred to the maintenance department where he was successively made assistant section foreman of the Houston yard, assistant roadmaster and roadmaster on the main line at Hearne, Tex. In 1913 he joined the staff of the St. Louis, Brownsville & Mexico Ry. and was given charge of a party making a re-survey for valuation work. It was on the completion of this work that he was given his present appointment, where he succeeds Charles Watkins, who has been made extra gang foreman on the Wabash R. R.

G. U. Middleton, recently appointed assistant division engineer on the Zanesville division of the Pennsylvania Lines west at Zanesville, Ohio, entered the service of the Chesapeake & Ohio as assistant on the engineering corps on the Richmond and later the Indianapolis divisions. In 1915 he was appointed pilot engineer in the department of valuation, where he remained until in his present appointment he succeeds F. V. Berkey, transferred to the Indianapolis terminal division.

A. L. Morrison, recently appointed foreman of section 57 on the Pittsburgh & Lake Erie, has resigned his position as supervisor of the Western Maryland Railroad at Confluence, Pa.

C. P. Noland, recently appointed roadmaster of the Birmingham Southern R. R. at Fairfield, Ala., succeeds J. F. Vance, promoted.

H. B. Pflasterer, recently appointed signal inspector of the Nashville, Chattanooga & St. Louis Ry., at Nashville, Tenn., entered the service of the C. & E. I. at Danville, Ill., in 1898 and after some work in a bridge construction gang became signal helper and worked his way up through the signal department there. In 1901 he was made signal maintainer and in 1904 was appointed fitter in the signal construction gang of the Nashville, Chattanooga & St. Louis at Nashville, Tenn. Later that year he was appointed signal foreman and in 1908 general signal foreman. In 1915 he was appointed supervisor of signals and has now been made general signal inspector.

Guy Pinner, recently appointed bridge engineer of the Seaboard Air Line, at Norfolk, Va., succeeds W. O. Scheuerman, assistant bridge engineer, resigned.

C. C. Ramsdell, recently appointed assistant general roadmaster on the Kansas division of the Union Pacific R. R. at Salina, Kan., was, previous to that appointment, roadmaster at Northport, Nebr.

M. J. Scott, recently appointed roadmaster of the Nebraska division of the Union Pacific at Northport, Nebr., worked as track laborer and section foreman for the Central of New Jersey from 1907 until 1913, when he joined the forces of the Union Pacific as extra gang foreman. In his recent appointment he succeeds C. C. Ramsdell, appointed assistant general roadmaster at Salina, Kan.

W. W. K. Sparrow, recently appointed valuation engineer of the Chicago, Burlington & Quincy at Chicago, entered railroad service in Ireland in 1898 and after service there and in Africa was employed in 1909 by Waddell & Harrington, consulting engineers at Kansas City. He was later associated with H. von Unwerth, and in 1913 he was made assistant chief engineer of the Missouri State Public Service Commission, where he remained until his recent appointment.

H. T. Sympson, recently appointed division engineer of the Western division of the Pennsylvania Lines west of Pittsburgh, began railroad work in 1903, with the Yazoo & Mississippi Valley R. R. at Vicksburg, Miss., serving one year as track apprentice. In 1904 he was made assistant engineer with the Alabama & Vicksburgh and Vicksburgh, Shreveport & Pacific Rys. at Vicksburgh, Miss. He entered the service of the Vandalia R. R. as assistant on engineer corps, chief engineer's department, in 1905, and served in that capacity until 1906, when he was made assistant engineer on construction work. From 1908 to 1911 he was in the chief engineers' office at St. Louis, having been transferred on the latter date to the Michigan division of the Vandalia as assistant division engineer. He was transferred to the St. Louis division of the Vandalia as assistant engineer in 1912. He now succeeds Harvey Hall, appointed assistant division engineer of the Western division, P. F. W. & C. Ry.

J. B. Thalken, recently appointed roadmaster on the Union Pacific R. R. at Laramie, Wyo., entered the service of that road in 1894 as a track laborer on the third district and in 1900 was appointed section foreman on the Wyoming division. He was later given charge of extra gangs at various points and in 1908 appointed foreman of the Buford gravel pit. In 1912 he was made foreman of the Cheyenne terminal yards and held that position until the announcement of his recent appointment.

A. M. Turner has recently been appointed district engineer in charge of track elevation on the Cleveland, Cincinnati, Chicago & St. Louis Ry. at Columbus, Ohio.

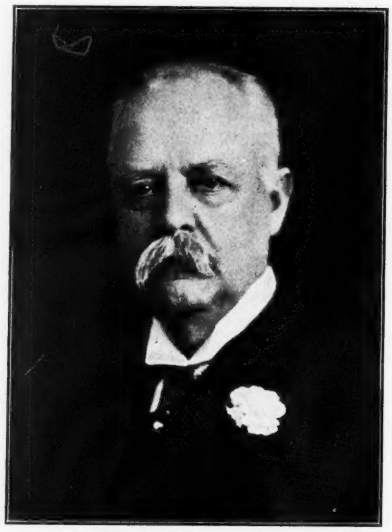
W. M. Vandersluis, signal engineer of the Illinois Central Railroad, has been appointed consulting signal engineer of the Central of Georgia Railway.

Charles M. Wheeler, recently appointed supervisor of signals of the Pennsylvania Railroad at Baltimore, Md., has been promoted from assistant inspector of signals at Philadelphia.

F. N. White, recently appointed supervisor of the Mobile & Ohio Ry. at Corinth, Miss., entered the service of the Mobile & Ohio in 1880 as laborer, was made apprentice in 1881, foreman in 1883, extra gang foreman in 1892 and in 1911 assistant supervisor, which position he held until his recent appointment.

Obituary

Theodore Voorhees, president of the Philadelphia & Reading Railway Co., died on March 12 last. The railroad world has lost an able executive. Mr. Voorhees was born in New York on June 4, 1847, and had therefore nearly reached man's alloted span of life. After graduating in 1869 from the Renssaeler Polytechnic Institute he joined the engineering staff of the Delaware, Lackawanna & Western and remained in that service for four



Theodore Voorhees

years, when he was appointed superintendent of the Syracuse, Binghamton & New York Railway. Following this service he was made superintendent of the Champlain division of the Delaware & Hudson system, which position he held until he was appointed assistant general superintendent of the New York Central, later becoming general superintendent. He was selected in 1893 as vice-president of the Philadelphia & Reading, in charge of operation. He filled this office until 1914, when he was elected president of that road to succeed Mr. Baer. Mr. Voorhees was a man of rare qualities and experience and was a member of many societies. His life was both busy and successful.

Book Review

Railroad Field Manual for Civil Engineers. By William G. Raymond, C.E., L.L.D., Professor Civil Engineering and Dean of the College of Applied Science in the State University of Iowa. A first edition, published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London. Price, $3.00.

This book is for use in the field, although adapted to both field and office use. It is replete with interesting subjects and the necessary tables for use in connection with these subjects. It treats of compound and simple curves, as well as the spiral. There is a chapter on Logarithms and other chapters on Location, Estimates, Turnouts and Crossovers, Adjustment of Instruments, Azimuth, Latitude and Time and Sexagesimal Trigonometrical functions. The author sends it forth hoping that it will meet with approval in some places; tried in other places and prove to be a work of value and not the outcome of fads or fancies. It seems to be a book worth having in such a collection of works as an enterprising railroad man requires. It is a sort of pocket edition easily carried; is well bound and therefore serviceable.

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